Demand Access System (DAS)

Critical Design Review

22 - 23 February 2001

Day 1 & 2

“DAS – Next Generation Multiple Access Service”

ITT Industries
Engineered for life

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Day 1

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CDR Agenda - Day 1

DAY 1	Duration	Briefer
1. CDR/DDR Introduction	0930 - 0950	Tom Gitlin
2. DAS Overview	0950 - 1020	Walt Kearns
3. DAS Ops Concept Overview	1020 - 1120	Charlie Hammond
4. SWSI Overview	1120 - 1150	Tom Sardella
	1 hr Lunch	
5. DAS Systems Engineering Summary	1250 - 1320	Charlie Hammond
6. DAS Verification Planning	1320 -1340	Charlie Hammond
7. DAS Design Overview	1340 - 1400	Ted Benjamin
	15 Min Break	
8. DAS Detailed HW Design	1415 - 1615	Gene McLeod

CDR Agenda - Day 2

DAY 2	Duration	Briefer
9. DAS Detailed Software Design	0930 - 1130	Bob Smarrelli
	1 hr Lunch	
10. SWSI Delta Design Review	1230 - 1445	Tom Sardella
11. ITT Summary	1445 - 1500	Walt Kearns
	15 Min Break	
12. CSOC Support Engineering	1500 - 1600	Skip Rutemiller Cliff Baxter
13. Government Caucus for RFAs		Tom Gitlin

Day-1 Agenda

1. **CDR/DDR Introduction**
   - **Review Board**
   - **CDR Purpose**
   - **NASA Oversight**
   - **DAS Interfaces**
   - **Risk Analysis Summary**
2. DAS Overview
3. DAS Ops Concept Overview
4. SWSI Overview
5. DAS Systems Engineering Summary
6. DAS Verification Planning
7. DAS Design Overview
8. DAS Detailed Hardware Design

Introduction

- The DAS effort will augment the Space Network (SN) by providing new beamformers, receivers, and associated control, monitor, and data distribution systems
- DAS will increase service capacity and enable new SN support capabilities
- DAS is a NASA/GSFC initiative approved by SOMO on March 2, 2000
- DAS is planned to be operational in April 2002
- Project documentation is available online at: http://stelwscpo.gsfc.nasa.gov/Das/

CDR Board Members

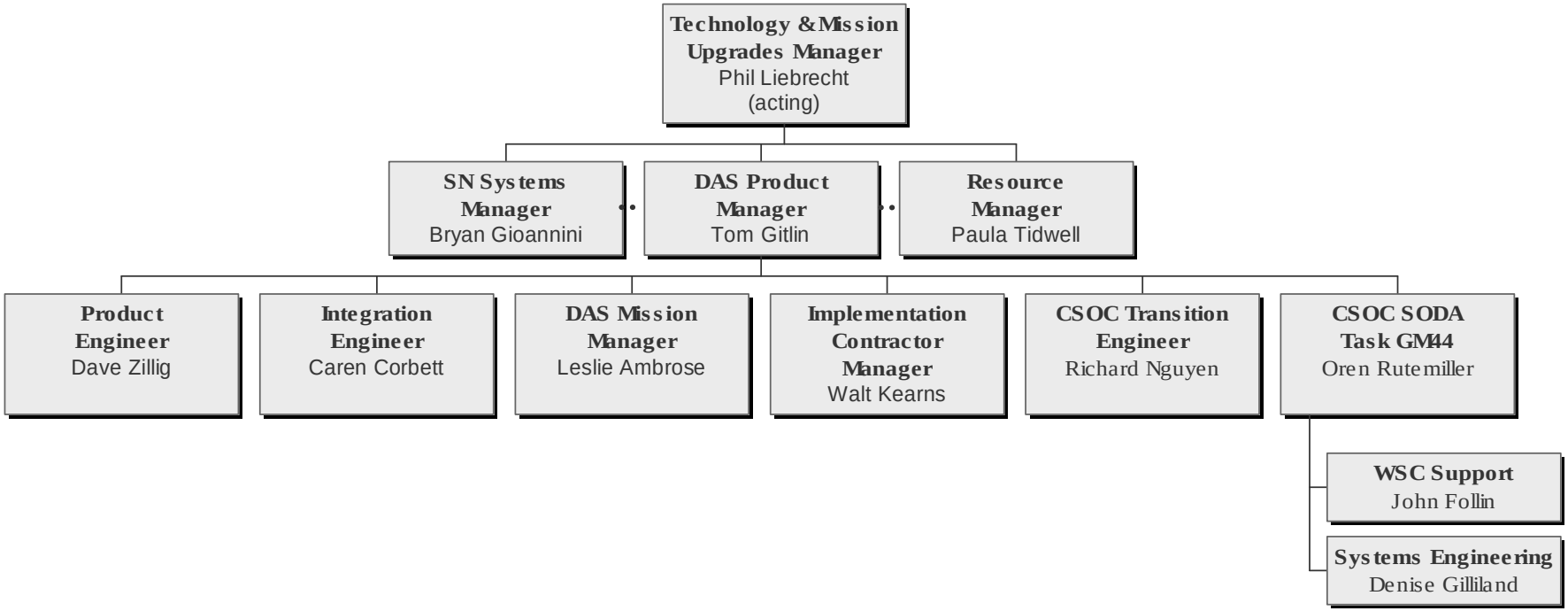
- Bryan Gioannini* – GFSC/Code 453/WSC (Chair)
- Ted Ackerson – GFSC/Code 303
- Jim Gavura* – GFSC/Code 452/WSC
- Dave Israel – GFSC/Code 567
- Steve Tompkins – GFSC/Code 481
- Jon Walker – GFSC/Code 451

* Participating from White Sands Complex

CDR Purpose

- **Conduct an independent peer review of the DAS and the Space Network Web Services Interface (SWSI) designs**
  - Evaluate system against requirements
  - Describe system design, test, and acceptance plans
  - Identify project and design risks; define mitigation strategies

Product Oversight



DAS Interfaces

- **Three External ICDs**
  - 451-ICD-DAS/SWSI, Customer Control & Status Interface
  - 453-ICD-DAS/WSC, WSC Facility & Legacy System Interface
  - 451-ICD-DAS/Customers, NISN and Telemetry Data Formatting Interface
- **Space Network Web Services Interface (SWSI) will be the interface between DAS and its Customers**

Risk Analysis Summary

Priority	Risk Identifier	Risk Assignee	Risk Name	Status
1	T. Gitlin	T. Gitlin	NISN Interface	Open
2	W. Kearns	W. Kearns	Requirements changes	Open
3	W. Kearns	W. Kearns	SWSI/DAS Interface	Open
4	W. Kearns	W. Kearns	LCM Interface Screens	Open
5	W. Kearns	W. Kearns	DASCON software development	Open
6	W. Kearns	W. Kearns	Operational Test Time	Open
	T. Gitlin	T. Gitlin	Receiver Procurement	*Closed*
	W. Kearns	W. Kearns	Third Party Demod Delivery	*Closed*
	W. Kearns	W. Kearns	IBUG Long Lead Time	*Closed*
	T. Gitlin	T. Gitlin	Product approval and/or award delays	*Closed*
	T. Gitlin	T. Gitlin	TGBFS Deployment	*Closed*
	W. Kearns	D. Gilliland/L. Ambrose	Archive/Server Requirements	*Closed*
	W. Kearns	O. Rutemiller	EMI Requirements	*Closed*
	W. Kearns	W. Kearns	Installation Schedule	*Closed*
	T. Gitlin	D. Lumsden	CSOC Support	*Closed*

NISN Support/Coordination Timeline

- **13 Nov 00 – Contacted Chris Spinolo/291 requesting assistance establishing connectivity with NISN**
- **12 Jan 01 – Contacted Brad Torain/290 requesting assistance with establishing connectivity with NISN**
- **31 Jan 01 – Added NISN Interface to Risk Summary**
  - Cannot output customer's mission data without NISN Closed IO/Net interface
- **31 Jan 01 - Appendix C (Compliance Checklist) from MOD 290-004 (IO/net Access Protection Policy and Requirements) submitted to Brad Torain/290**
- **1 Feb 01 – Received call from Chuck Duignan/291 explaining:**
  - Appendix C was forwarded to Bernie Tomardy/291 for analysis
  - Chris Spinolo/291 will be the POC for DAS regarding NISN support
  - Shuby Ambardekar/CSOC is the Customer Support Representative

- **Lack of progress has impacted development of a complete ICD**
- **Tracking open Action Item since November**

Next

Day-1 Agenda

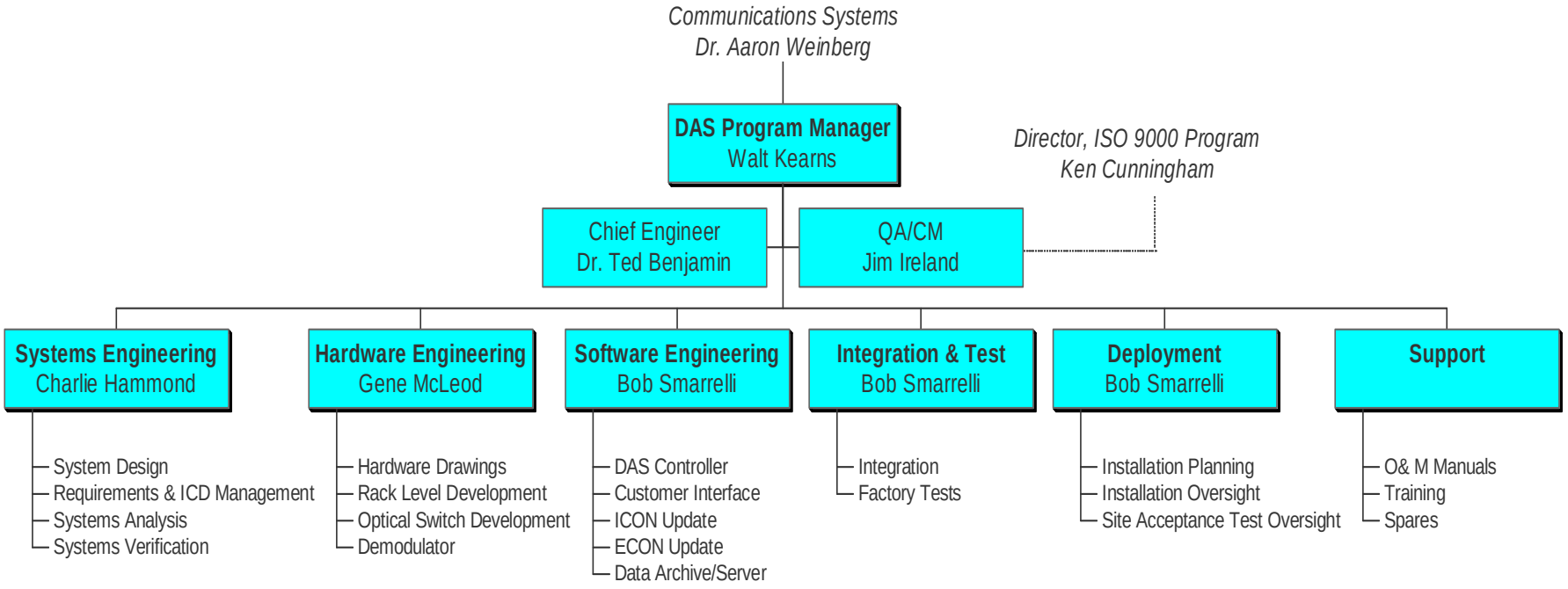
1. CDR/DDR Introduction
2. **DAS Overview**
   - **Objectives**
   - **ITT Program Organization**
   - **Program Schedule**
   - **Resolution of Key PDR Requirement Issues**
3. DAS Ops Concept Overview
4. SWSI Overview
5. DAS Systems Engineering Summary
6. DAS Verification Planning
7. DAS Design Overview
8. DAS Detailed Hardware Design

Program Concept

- **DAS is intended to capitalize on the Third Generation Beamforming System (TGBFS) by expanding TDRSS MA Services through adding demodulation, switching, formatting and storage, and distribution capabilities. ITT will:**
  - Use COTS TGBFS IBUGs to provide core beamforming capabilities
  - Modify the software of a COTS ITT programmable MA demodulator to handle DAS MA-return capabilities.
  - Add COTS switching between EMCs and Beamformers, and between Beamformers and Demodulators
  - Add data formatting and COTS archiving capabilities
  - Modify existing TGBFS controllers to interface with DAS, add demodulator controller and system controller using COTS processors
  - Use the SWSI system for customer request and status exchange; and the NISN IONET for customer return telemetry data transport
- **DAS is primarily a semi-custom COTS integration effort with extensive software development to achieve the required service capabilities.**

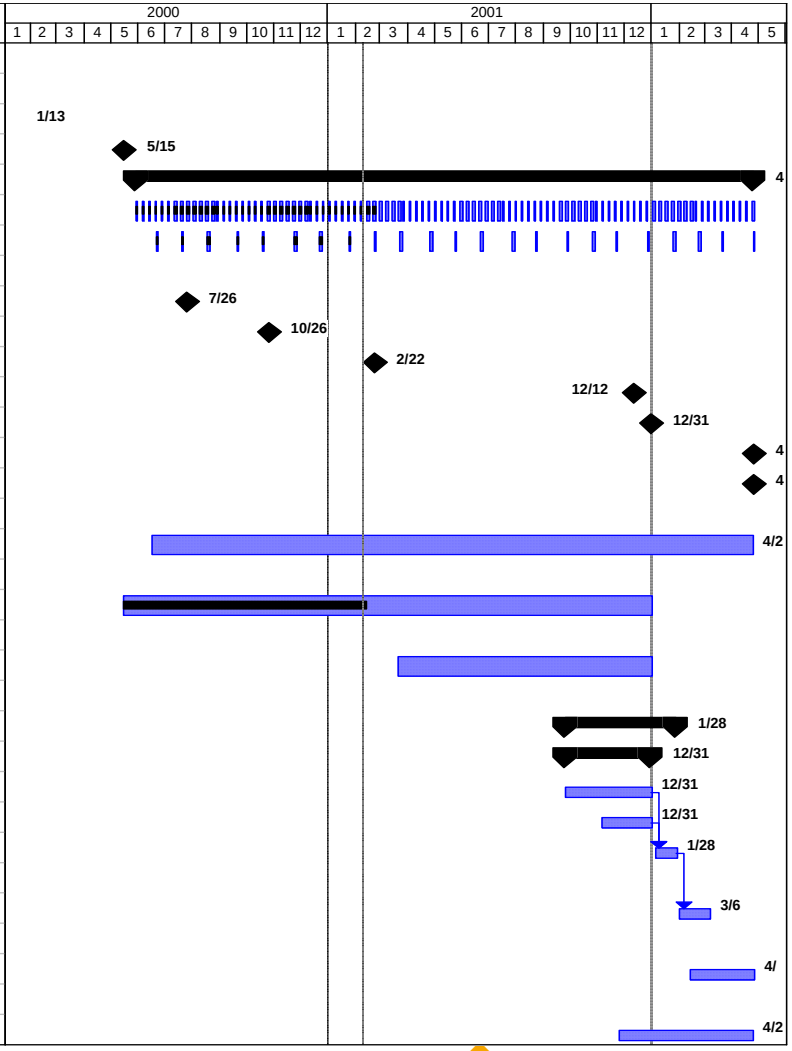
Software is the largest development effort.

ITT DAS Organization



Overall Schedule

ID	Task Name	Duration	Start
1	**Summary Schedule**	0 days	Mon 1/3/00
2			
3	**NASA GSFC Start**	0 days	Thu 1/13/00
4	**ITT Industries Start**	0 days	Mon 5/15/00
5	**Status Meetings**	**499 days**	**Mon 5/29/00**
6	**Weekly Status Review**	**497 days**	**Mon 5/29/00**
107	**Monthly Status Review**	**482 days**	**Wed 6/21/00**
131	**Major Milestones**	**456 days**	**Wed 7/26/00**
132	System Requirements Review	0 days	Wed 7/26/00
133	Preliminary Design Review	0 days	Thu 10/26/00
134	Critical Design Review	0 days	Thu 2/22/01
135	Test Readiness Review	0 days	Wed 12/12/01
136	Development Complete	0 days	Mon 12/31/01
137	Operations Readiness Review	0 days	Thu 4/25/02
138	Operations Capability	0 days	Thu 4/25/02
139			
140	**CSOC Site Planning and Verification**	485 days	Thu 6/15/00
141			
142	**Design and Development**	426 days	Mon 5/15/00
143			
144	**System Integration**	206 days	Mon 3/19/01
145			
146	**System Testing**	**90 days**	**Tue 9/25/01**
147	System Design/Performance Verification Testing (WSC & Factory)	**70 days**	**Tue 9/25/01**
148	All CI's except DASCON	70 days	Tue 9/25/01
149	DASCON SDVT	41 days	Mon 11/5/01
150	Factory Verification Testing	18 days	Thu 1/3/02
151			
152	**Shipping and Installation**	26 days	Wed 1/30/02
153			
154	**Site Testing and Training**	53 days	Tue 2/12/02
155			
156	**Site Transition to Completion**	109 days	Fri 11/23/01



ITT Document Delivery Status

DRL No.	Deliverable	Document Number	Current Revision	Estimated Delivery Date	Level of CM Control	Type of File
1	Product Management Plan	028-600000	Rev. A	12/15/2000 (A)	CR	MS Word
2,3	QA/CM Plan	QM-01	Rev. B	7/24/2000 (A)	CA	Acrobat
4	Schedule	-	Rev. A	12/15/2000 (A)	N/A	MS Project
6	Detailed System/Subsystem Specification	033-600004	Rev. A	12/15/00 (A) 02/21/01 (A)	CR	MS Word
7	Internal Interface Control Document	014-600006	Rev. A	10/25/00 (A) 02/21/01 (A)	CR	MS Word
8	Software Design Documentation	Various		Draft CDR + 90 days Final ORR - 30 days		MS Word
9	Hardware Design Drawings	Various		Draft CDR + 90 days Final ORR - 30 days		Various
10	Site Preparation and Installation Plan	028-600031		Draft TRR -60 days Final TRR -30 days		MS Word
11	Acceptance Test Plan & Procedures			-		
	- Verification Plan - Vol I (Combined System/Subsystem/CI Plan)	009-600085	Rev -	02/21/01 (A) Final CDR + 90 Days	CR	
	- Test Procedures - Vol II	009-600086		Draft CDR + 60 days Final CDR + 90 days		MS Word
	- Factory Acceptance Test Plan & Procedures - Vol III	009-600087		Draft TRR - 30 days Final TRR		
	- Site Acceptance Test Plan & Procedures - Vol IV	009-600088		Draft Ship - 30 days Final Ship - 1 day		

CA Change Authorization needed prior to changing document
CR Change Record make to reflect changes in docoument
N/A Controlled document, without formal change process
Final

ITT Document Delivery Status - 2

DRL No.	Deliverable	Document Number	Current Revision	Estimated Delivery Date	Level of CM Control	Type of File
12	Performance Verification Matrix	024-600007	Rev. A	02/15/2001 (A)	CR	Acrobat
13	Acceptance Test Report	035-600008		15 Days after Test Final at ORR		MS Word
14	Inspection & Analysis Report	035-600009		15 Days after Test Final at ORR		MS Word
16	RMA Analysis Report	035-600010	Rev. A	10/25/00 (A) 02/21/01 (A)	CR	MS Word
17	Operations and Maintenance Manual	015-600012		Draft TRR - 30 days Final at TRR		MS Word
	Operations and Maintenance Manual for the Demodulation Group Unit	015-147007		Draft TRR - 30 days Final at TRR		
18	Training Plan and Materials			-		TBD
	- Training Plan	TBD		Draft TRR - 30 days Final at TRR		
	- Training Materials	TBD		Draft TRR - 30 days Final at TRR		
19	Integrated Logistics Support Plan	028-600011	Rev. A	10/25/00 (A) 02/21/01 (A)	CR	MS Word

CA Change Authorization needed prior to changing document
CR Change Record make to reflect changes in docoument
N/A Controlled document, without formal change process
Final

Disposition of Action Items Due at CDR

AI #	Action	Disposition
46	Incorporate RFA 144-4 Alerts	See CDR p 9-47 and the Alert GUI Demonstration
72	Deliver DAS-SWSI ICD	1st Draft Delivered 02/15/01
76	List deliverable SW Licenses, Operating Systems and Developmental use Software	See Next Slide and CDR pp 9-2 through 9-5
87	Determine bandwidth requirements for DAS	See CDR p 9-90
91	Define PTP Functionality to be implemented by DAS	See White Paper and CDR pp 9-76 through 9-78
92	Present DAS SLOC Estimates	See CDR p 9-6
93	Deliver DAS-Customer ICD	Delayed pending NISN interface definition. Estimate 03/30/01

Preliminary DAS License List

Item	QTY	Location						
		DASCON	DCON	ICON	PTP	F.O. SW	IBUG	DMG
Operational								
Red Hat Linux 6.2	1	1						
Oracle 8i version 8.1.6 Standard 733MHZ	1	1						
Windows NT 4.0 Terminal Server	6		2	2	2			
Avtec PTP 1.49	6				6			
VxWorks Runtime Target Licenses	6					1	3	2
WSC Maintenance (Annual O&M)								
Oracle 8i Support Annual								
Avtec PTP Software								
Avtec PTP Hardware								
Tornado Standard: Support and Maintenance								
Development								
INTEL GNU C/C++ compiler 2.91.66								
INTEL GNU Linker								
INTEL GNU Source Level Debugger								
Telnet								
Python 1.5.2								
TCL/TK 8.0.5								
MS Visual C/C++ 5.0								
MS Access 97								
VxWorks OEM License: Motorola PPC750								
VxWorks OEM License: Support and Maintenance								

Requirements Resolution

(Raised at PDR)

- **Data Formatting**
  - RFA 450/145-01 replaces CCSDS SLE with requirement to “mimic current WDISC telemetry formats”
  - NASA defined header formats as
    - Standard Formatted Data Unit (SFDU)
    - AXAF-I SFDU
    - ACE SFDU
    - Low Earth Orbit – Terminal
    - Internet Protocol Data Unit (IPDU)
    - Standard TCP/IP
  - **Detailed design using AVTEC PTP in-progress; no current issues; implementation design not yet finalized**
- **SWSI as Customer Interface**
  - Original DAS concept envisioned direct DAS-Customer Interface
  - DAS SRD update requires use of SWSI as the Customer Interface
  - New DAS-SWSI ICD developed
  - **DAS-SWSI interface design in-progress; no current issues implementation design not yet finalized**

Requirements Resolution (Cont'd)

- **DAS SRD / Receiver RFI differences**
  - Resolved
  - **No issues**
- **Security**
  - Revised requirement will apply WSC, SWSI and NISN IONet Security Plans to DAS
  - DAS will be designated a Mission (MSN) resource within the WSC, SWSI and NISN IONet security envelop
    - The SN is a MSN resource
    - DAS will be an extension of the SN
  - Impact assessment: Minimum
  - **Detailed design assessment in-progress; no current issues; implementation design not yet finalized**

Detailed implementation designs for Data Formatting, SWSI and Security will be addressed as Special Topics in subsequent MSR's and distributed to the CDR distribution list.

Key Areas of Implementation Risk

- **PTP - Implementation details still to be defined**
  - How to collect needed data and populate some header fields
  - How to enable user choices in implementing optional processing
- **SWSI - Implementation details still to be defined**
  - XML exchanges between DAS and SWSI
  - All changes in customer interactions will impact both DAS and SWSI and the DAS-SWSI interface
- **Security - Implementation details still to be defined**
  - Allocation of certain security requirements between the operating system software and if needed a DAS-specific overlay
- **DASCON - Represents a large software development (~ 36K SLOC)**
  - Size and complexity are risks
  - Significant in-place and established procedures to efficiently design, develop, integrate and test software development efforts of this size

Day-1 Agenda

1. CDR/DDR Introduction
2. DAS Overview
3. **DAS Ops Concept Overview**
   - **Customer Service Scheduling Request**
   - **Resource Allocation & Scheduling**
   - **Service Operations**
   - **Anomaly Operations**
4. SWSI Overview
5. DAS Systems Engineering Summary
6. DAS Verification Planning
7. DAS Design Overview
8. DAS Detailed Hardware Design

DAS Ops Concept Introduction

- **DAS via SWSI provides an interface to request Multiple Access Return (MAR) Services and retrieval of Archived Data Services for customer playback**

- **DAS via SWSI serves as a Planning Tool and Scheduling Tool for Customers**
  - Planning includes computation of customer emitter line-of-sight visibility time periods to TDRS and identification of TDRS handovers, if needed
  - Scheduling includes processing Customer requests for MAR or Playback services

- **DAS via SWSI will notify Customers on the Status of all Scheduled and On-going Services, and Service Requests**

Operator/Man-Machine Interfaces

DAS Local Control and Monitor (LCM)

DAS LCM consists of three GUIs on three separate monitors:

1. DASCON

- Directly controls Archive/Server
- Interfaces with ICON and DCON for status/control of DAS equipment
- Provides GUI for overall DAS Operations
- Serves as a partial Backup for SWSI in event of DAS/SWSI connection outage

2. ICON

- Directly controls IBUGs and Optical Switch
- Interfaces with DASCON
- Provides fault isolation at and below the LRU level

3. DCON

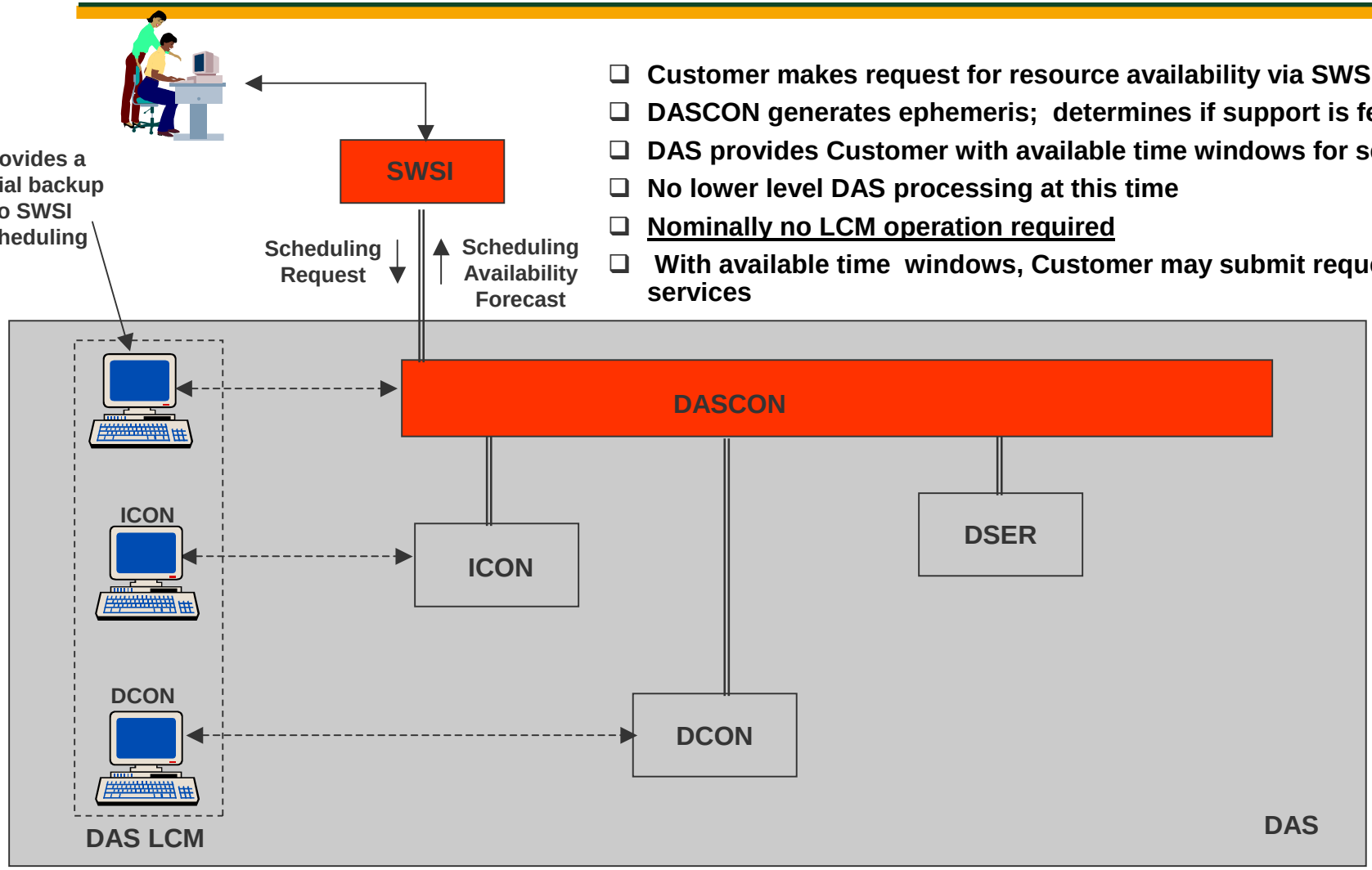
- Directly controls Demodulator Groups (DMGs), IF Switch and Temperature Monitor
- Interfaces with DASCON
- Provides fault isolation at the LRU level
- DMG Front Panel Display (FPD) supports fault isolation below the LRU level

Primary and Backup Customer Interfaces

- **Customers access DAS through a SWSI terminal workstation in their Mission Operations Centers (MOC)**
  - At the customer MOC location, personnel can be assigned SWSI login names/passwords, and given access to DAS
  - Customer authentication and authorization checks are performed to ensure the login and password are valid
  - For each SIC, Customer personnel may tailor default Service Specification Code (SSC) configuration data set profiles to facilitate service planning
  - Customers may specify destination (TCP Port number and IP address) to be supported on the NISN Closed and Open IOnets through the NISN Secure Gateway

- **DAS Local Control and Monitor (LCM) provides a partial backup for SWSI should that connection from the Customer to DAS be down**
  - Local Control Center operators at WSC may input Customer service requests by telephone using a generic template GUI with no “pre-canned” SSC parameters
  - Upon request, LCM operators may reconfigure on-going services or modify existing service requests
  - They can take action to follow up on Alert conditions with Customers, if warranted

Resource Availability and Scheduling



- Customer makes request for resource availability via SWSI
- DASCON generates ephemeris; determines if support is feasible
- DAS provides Customer with available time windows for service
- No lower level DAS processing at this time
- Nominally no LCM operation required
- With available time windows, Customer may submit request for services

Customer Planning

- **Planning assists a DAS Customer in identifying periods of resource availability for future scheduling. When a future service period is identified, this stipulates that:**
  - DAS resources (IBUs and DMUs) will be available from a pool of shared resources, but specific equipment is transparent to users
  - Visibility between a selected TDRS and a customer emitter is possible (with good ephemeris data provided by the Customer)

- **In requesting periods of service availability, the Customer provides:**
  - Start and Stop times within which the service is desired
  - Service duration
  - Spacecraft identifier (SIC) and the desired TDRS(s)
  - A user can also select 'ANY' TDRS that may be in view, or multiple TDRSs can be selected
  - A maximum number of available time windows may be selected

- **In response to this request, DAS will return a list of available time windows that meet the request along with the TDRS ID(s)**
  - For Dedicated Customers – that is, Customers "Guaranteed Service" -- an impact designator for each identified service period will indicate whether or not non-dedicated customers will be "bumped" if the service is selected
  - For Non-dedicated Customers, service pre-emption is always possible

Resource Allocation

Non-Dedicated vs Dedicated

- **Dedicated Customers are always guaranteed service. Dedicated Customer requests can be allocated to resources that have already been previously allocated to a Non-Dedicated Customer, and hence are 'guaranteed' service**

- **Non-dedicated Customer requests are assigned within the resources remaining after allocation to Dedicated Customers**
  - If a Dedicated Customer "bumps" a scheduled Non-Dedicated Customer, the Non-Dedicated Customer is notified
  - Implicit here is that NASA buys sufficient "non-dedicated" resources to meet a probability of obtaining service

User Service Request and Scheduling

- **DAS Customers schedule services based on stored Service Specification Codes (SSCs)**
  - These are service configuration parameters established for a specific Customer SIC
  - SSCs can be stored per SIC by SWSI and used to facilitate scheduling requests

- **MAR Services may be requested up to 30 seconds prior to service initiation**
  - For future time periods, the implication is that shared resources are available and there is TDRS line-of-sight visibility
  - An Active Service Schedule will be provided for all services being scheduled within 96 hours, updated as required
  - Based on last ephemeris, Dedicated Customers are scheduled up to 96 hours in advance
  - Based on last ephemeris, Non-Dedicated Customers are scheduled 72 hours in advance
  - If Non-Dedicated Customers are “bumped”, they will be notified

- **The Active Schedule shows Playback Services along with MAR services**
  - Specific Event Details with applicable SSCs can be called up by a Customer for a scheduled MAR or a playback service

SSC Parameters

Item No.	Information Identifier	Information Description
1	SSC Profile Identifier	Alphanumeric assigned to this profile
2	Modulation	BPSK; SQPN-single channel, SQPN-dual channel
3	Independent Beamforming Unit (IBU) Mode	Default IBU Mode: Adaptive Mode; Fixed Weight Mode; Fixed Weight Mode with Calibration; Fixed Weight Mode with Adaptive Pointing
4	SIC PN Code Assignment	Pseudo-Random Noise Code
5	Symbol Format – I Channel	NRZ; Biphase
6	Symbol Format – Q Channel	NRZ; Biphase
7	Data Format – I Channel	L; S; M
8	Data Format – Q Channel	L; S; M
9	Acquisition Mode	Mode A (700 Hz); Mode B (3000 Hz)
10	Carrier Frequency Reference	Hz. Transponder "best lock" frequency
11	Data Rate - I Channel	Bits per Second (Bps)
12	Data Rate - Q Channel	Bits per Second (Bps)
13	IP Address – I Channel	IP Address
14	IP Address – Q Channel	IP Address
15	Port Number – I Channel	TCP Port Number
16	Port Number – Q Channel	TCP Port Number
17	Storage Duration	Data storage duration in Days
18	Maximum Data Rate – I Channel	Bps
19	Maximum Data Rate – Q Channel	Bps
20	Protocols (Data format)	ACE, AXAF-I, IPDU, LEO-T, SFDU

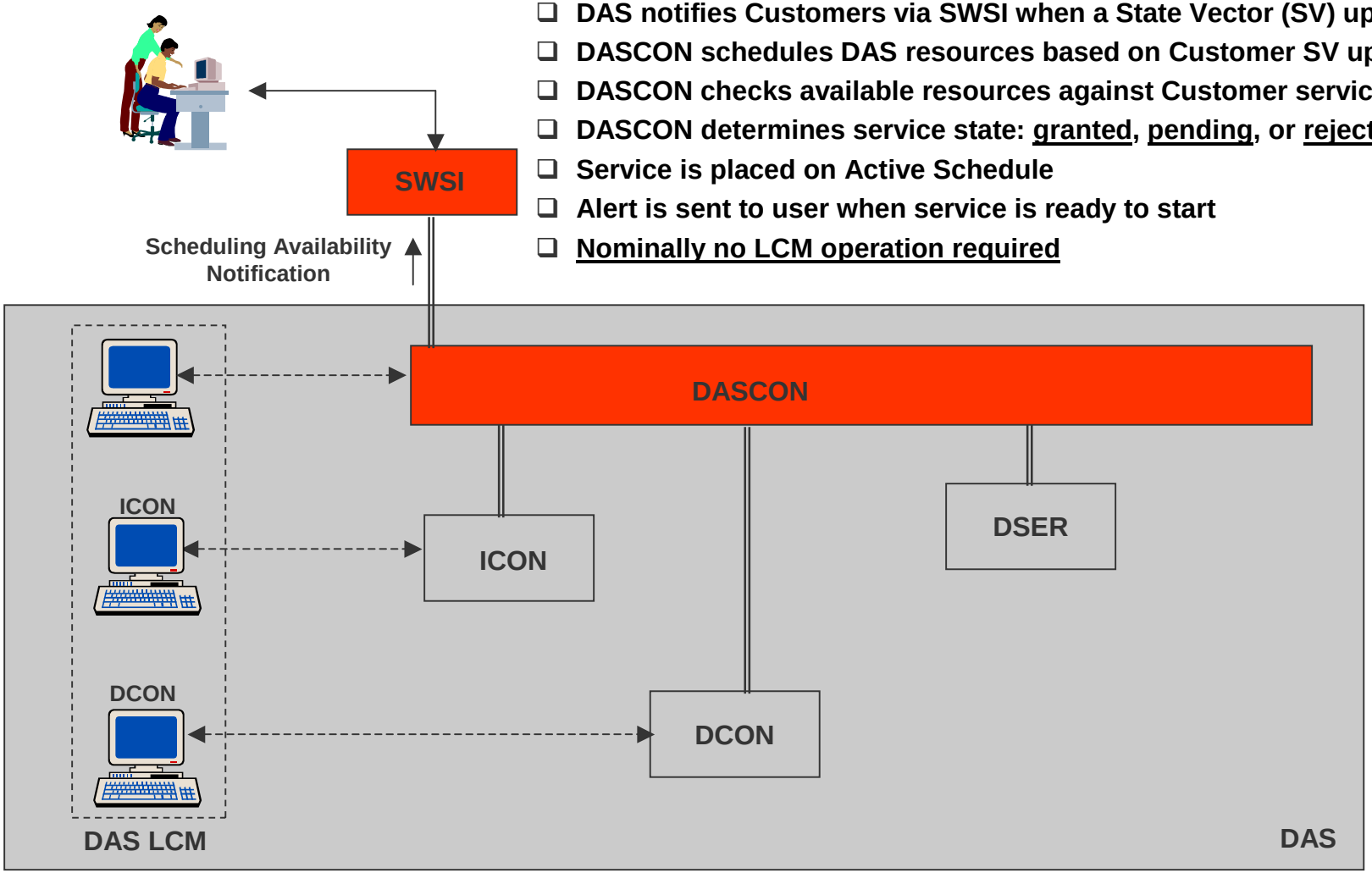
Re-configurable during Service

Note: ICD to reflect Item #4 is re-configurable.

96-Hours Prior to Service Scheduled Start

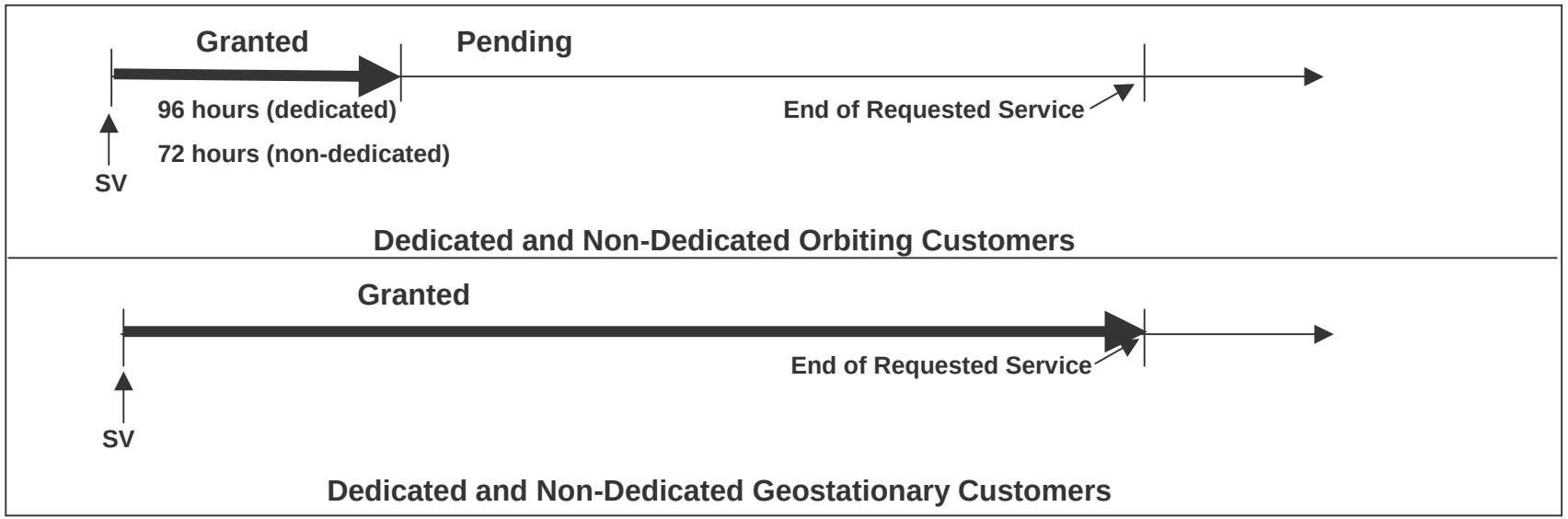
(Dedicated Customer)

- DAS notifies Customers via SWSI when a State Vector (SV) update is due
- DASCON schedules DAS resources based on Customer SV update
- DASCON checks available resources against Customer service needs
- DASCON determines service state: granted, pending, or rejected
- Service is placed on Active Schedule
- Alert is sent to user when service is ready to start
- Nominally no LCM operation required



Service States

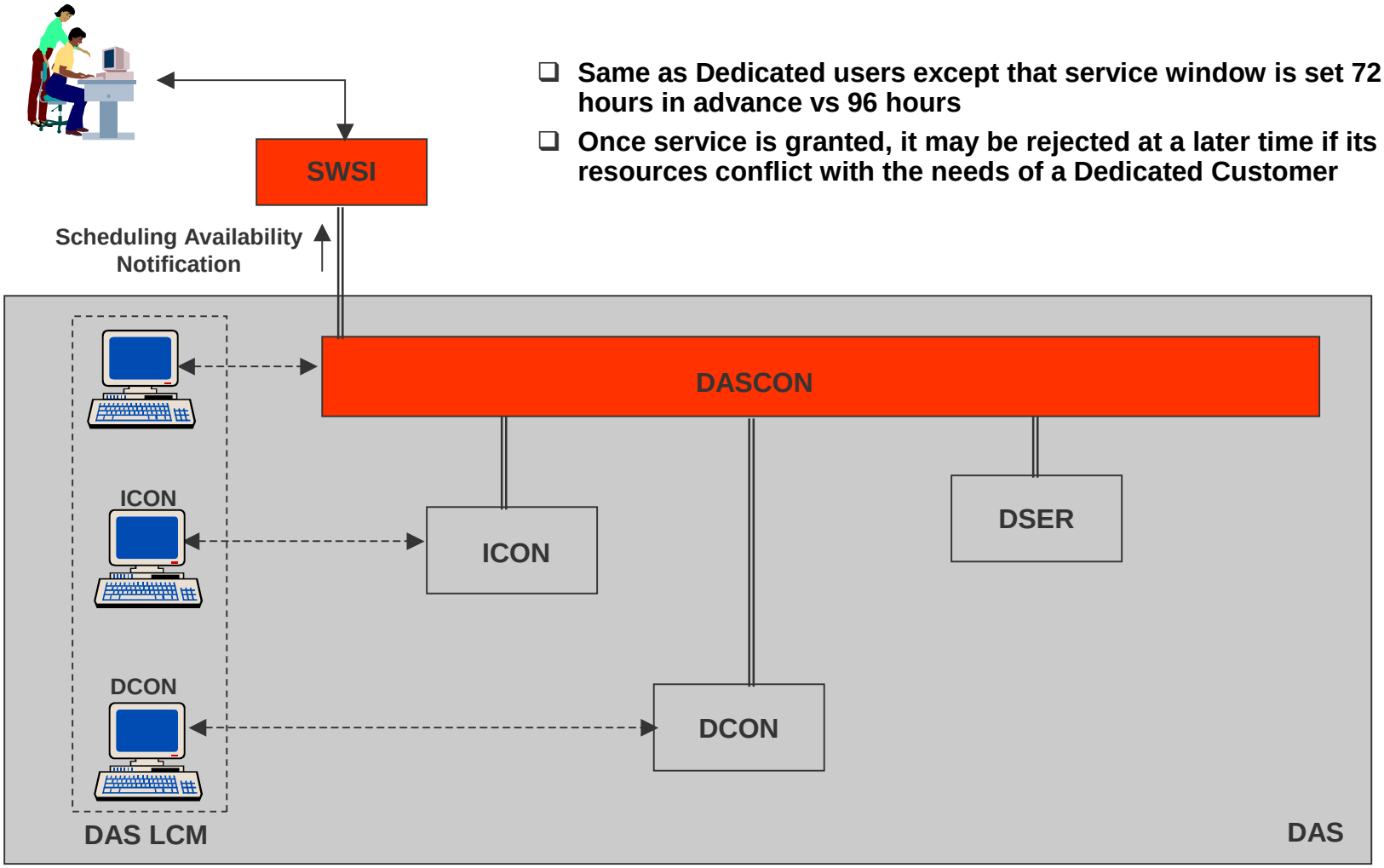
- **Service States include Granted, Pending and Rejected**
  - Granted – State Vector is current (within 96 hours) and resources are available
  - Pending – State Vector can not be propagated this far or is not current, or resources have not been identified
  - Rejected – No resources are available or TDRS requested is not available (all or nothing)
- **Pending applies to orbiting customer emitters and non geostationary platforms**
- **Even when Granted, all non-dedicated customer services can be pre-empted**



72-Hours Prior to Service Scheduled Start

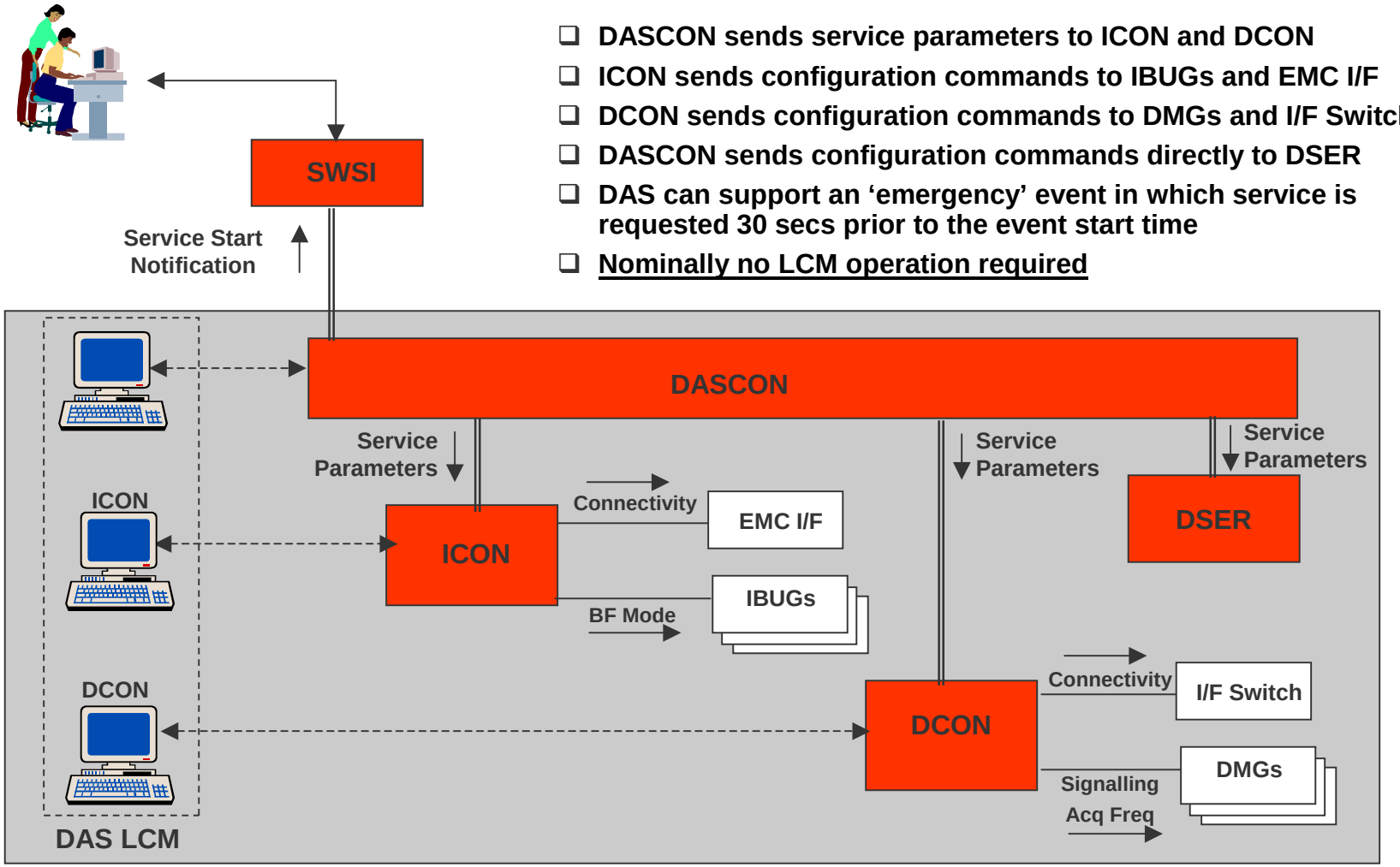
(Non- Dedicated User)

- Same as Dedicated users except that service window is set 72 hours in advance vs 96 hours
- Once service is granted, it may be rejected at a later time if its resources conflict with the needs of a Dedicated Customer



2 Minutes Prior to Service Scheduled Start

- DASCON sends service parameters to ICON and DCON
- ICON sends configuration commands to IBUGs and EMC I/F
- DCON sends configuration commands to DMGs and I/F Switch
- DASCON sends configuration commands directly to DSER
- DAS can support an 'emergency' event in which service is requested 30 secs prior to the event start time
- Nominally no LCM operation required



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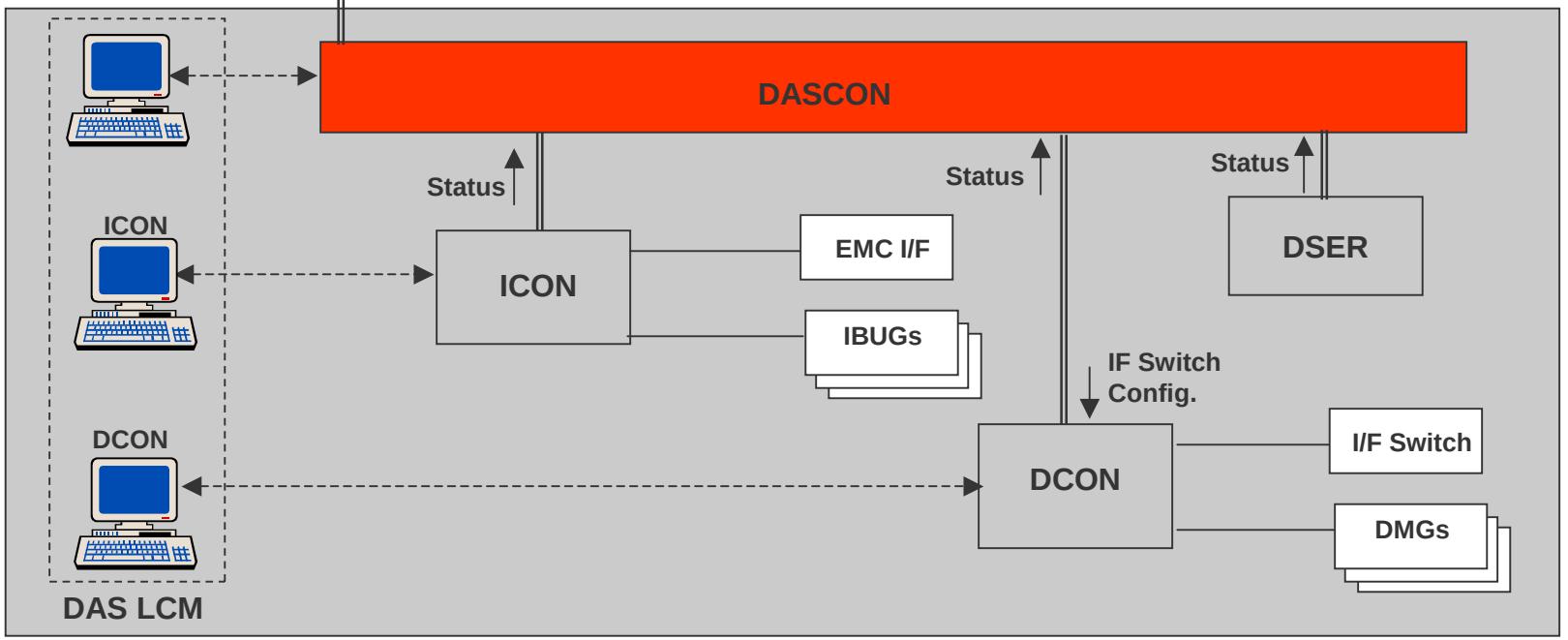
During Service Support

Nominal Operations - DASCON



- Reports service performance to SWSI once per minute
- Collects status every 1 sec from DCONs, ICONs and DSER
- Logs status data in database
- DASCON sends IF Switch Configuration commands during service to support TDRS handover operations
- Nominally no LCM operation required

Customer Feedback Mechanisms

- **DAS Customers are kept updated on the status of their individual services and service requests through SWSI:**
  - Alerts: Free-form text message providing various Customer notifications
    - Data storage limits
    - Non-Dedicated Customer being bumped
    - Customer State Vector needs updating
  - Request Status Summaries
  - Active Schedule
  - User Performance Data (UPDs) Messages

- **DAS generates UPD Messages once per minute**
  - A Customer may elect to not receive UPDs
  - UPD provide the performance status of all on-going services

UPD Parameters

Item No.	Parameter	Status
	Dynamic	
1	Received Carrier Frequency Estimate	Hz. With RF Doppler removed
2	Eb/N0 Estimate (BER & C/N0 can be derived from this quantity given certain assumptions)	dB
3	Lock Status	Lock / No-Lock
	Static	
1	Modulation	BPSK; SQPN-single channel; SQPN-dual channel
2	SIC PN Code	Pseudo-Random Noise Code (NASA Codes 1-85)
3	Acquisition Mode	Mode A (700 Hz); Mode B (3000 Hz)
4	Carrier Frequency Reference	Hz
5	Protocols (Data Format)	ACE, AXAF-I, IPDU, LEO-T, SFDU
6	IBU Mode	Beamforming Mode
7	Data Rate – I Channel	Bps
8	G2 Symbol Inversion – I Channel	Upright or Inverted
9	Symbol Format – I Channel	NRZ; Biphase
10	Data Format – I Channel	L; S; M
11	Data Rate – Q Channel	Bps
12	G2 Symbol Inversion – Q Channel	Upright or Inverted
13	Symbol Format – Q Channel	NRZ; Biphase
14	Data Format – Q Channel	L; S; M

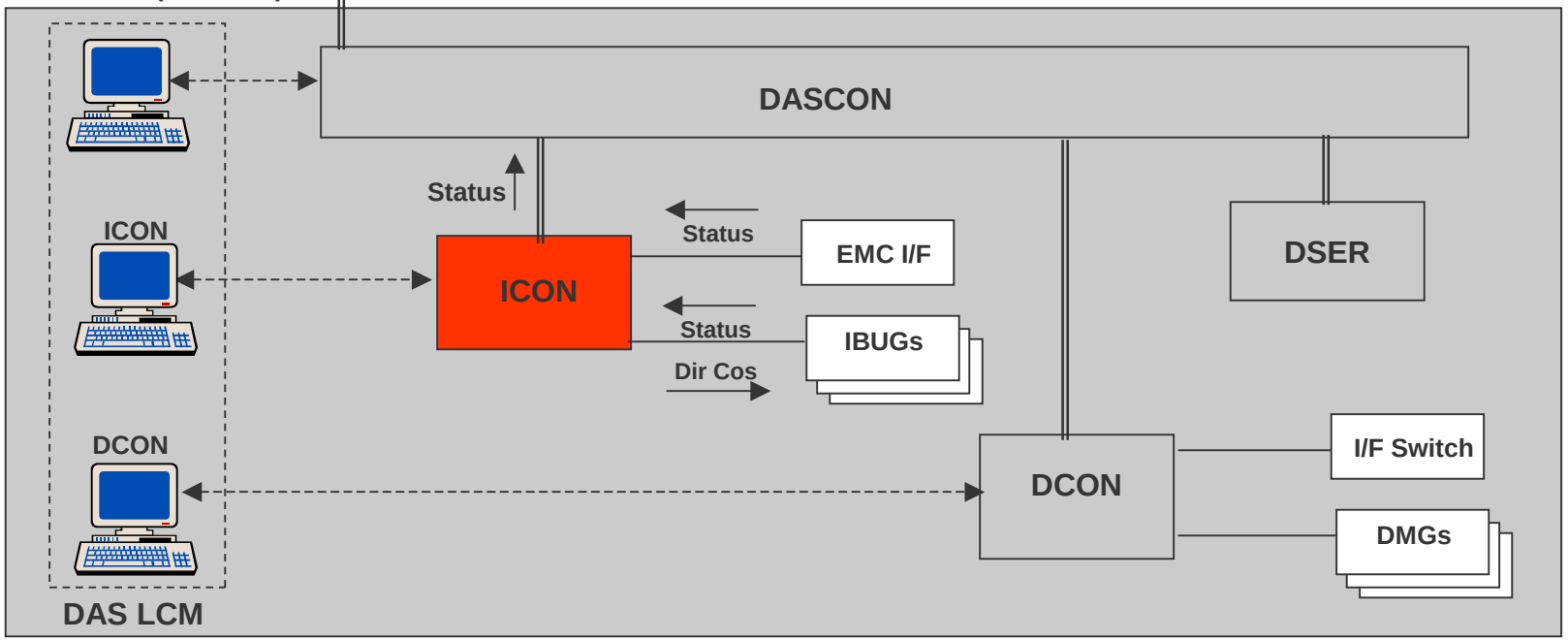
Service Modifications and Reconfigurations

- **DAS Customers may modify or delete requested services at any time**
- **Once the service starts, a DAS Customer may request reconfigurations of most of the service configuration parameters (SSCs) in near real-time as shown previously on slide 3-9**
- **Should a receiver signal lose lock, DAS automatically attempts to re-acquire the signal**
  - A Customer may request a forced re-acquisition

During Service Support

Nominal Operations - ICON

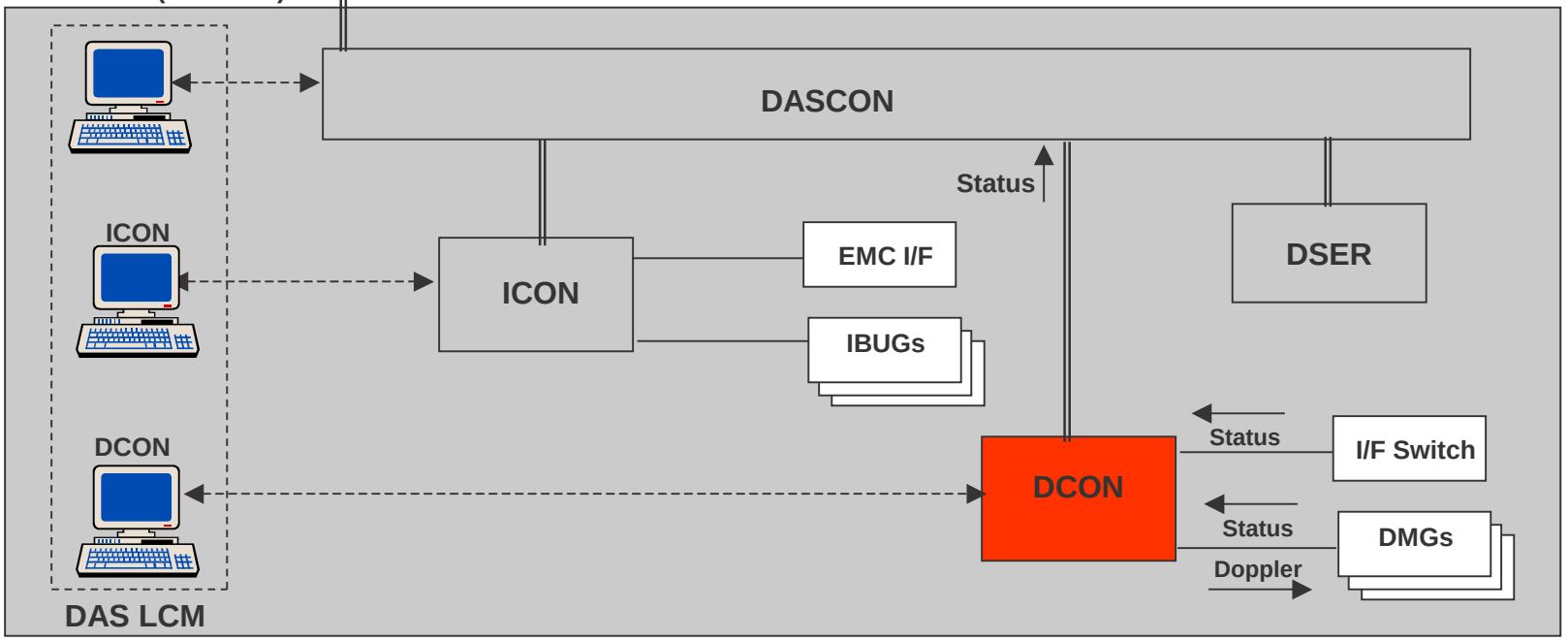
- ICON operates independently of DASCON
- Reports status to DASCON every 1 sec
- Collects status every 1 sec from IBUGs and EMC I/F CI
- Propagates user and TDRS orbits in near real time
- Computes and provides Direction Cosines to all IBUG Control Processors for computation of beam weights every 6.5 secs
- <u>Nominally no LCM operation required</u>



During Service Support

Nominal Operations - DCON

- DCON operates independently of DASCON
- Reports status to DASCON every 1 sec
- Collects status every 1 sec from DMGs and I/F Switch
- Propagates user and TDRS orbits in near real time
- Computes and provides Doppler Correction data to all DMGs Control Processors for frequency correction every 10 secs
- Nominally no LCM operation required



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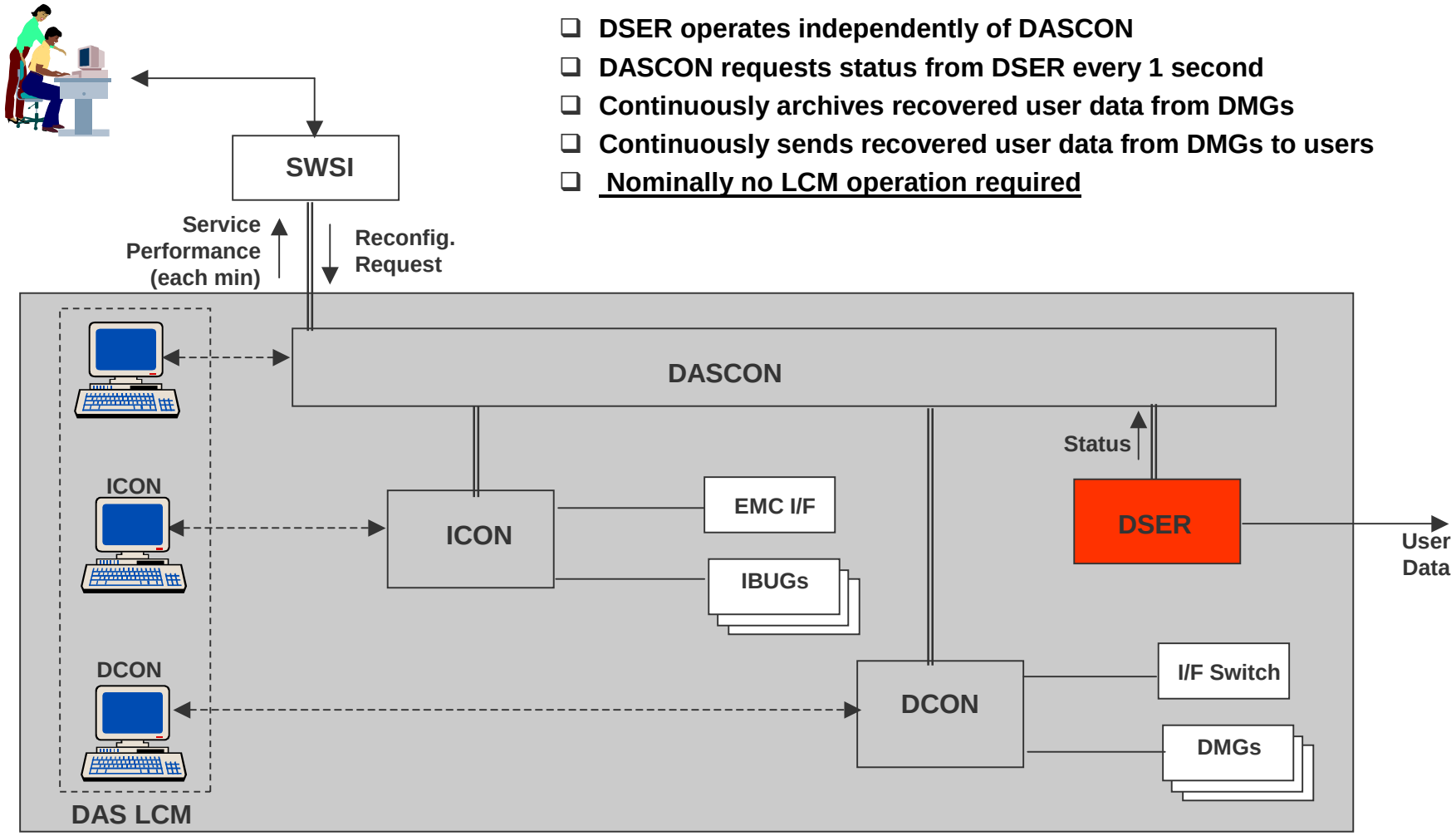
During Service Support

Nominal Operations - Archive/Server

- DSER operates independently of DASCON
- DASCON requests status from DSER every 1 second
- Continuously archives recovered user data from DMGs
- Continuously sends recovered user data from DMGs to users
- Nominally no LCM operation required



Customer Data Archiving
Nominal Operations

- **DAS provides real-time data to Customers during service**
- **DAS also archives user data**
  - DAS routes user data upon user request (i.e., no FTP access by users) at a rate dependent on the bandwidth that NISN IOnet can support
- **Users request data archiving duration in the Customer SSC for each SIC**
  - SSC specifications address the length of time that user data is archived (7 days default; up to 30 days)
  - DAS automatically removes data when time expires or a default time is passed
  - Users are notified when their data storage duration limit is approaching
- **DAS generates an alert when the RAID storage capacity reaches some pre-determined threshold, and purging can be used to recover available storage capacity**
  - At 95% disk full or at a specified preset threshold value, the DASCON takes proactive action to recover storage by deleting user data files - 'first-in-first-out' one by one to a level of 50% available storage space
  - DAS customers are notified beforehand, if this occurs

Playback Planning & Scheduling Operations

- **To search for archived telemetry data files for Playback, the Customer provides Start and Stop times to be searched; and the spacecraft identifier (SIC)**

- **DAS will perform a search of all archived files for the specified SIC between the requested time window start and stop times**

- **In response to a Playback Search Request, DAS will return a list of available files (time segments) for playback that fall within the time window**
  - Each time a receiver loses signal LOCK, a file is closed; and a new file is opened when the receiver signal is reacquired
  - While this may present a large number of files for a customer to scroll through, it will be easy to quickly identify periods when no service was being provided

- **As a final step, the Customer can then select a specific single file for playback and then proceed with scheduling a time to download the file at a specified TCP port number and IP address**

Customer Data Routing

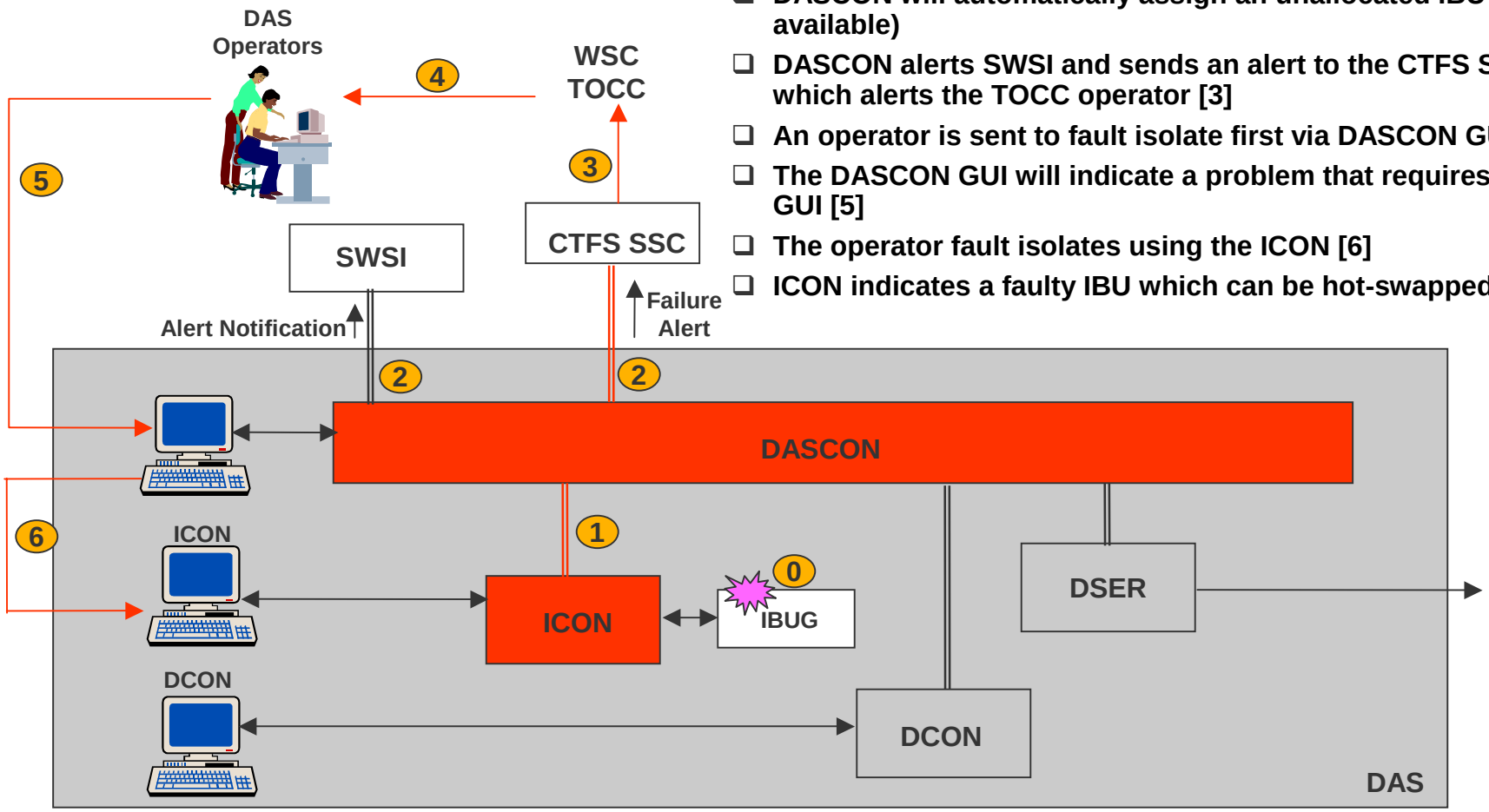
- **Real time and Archived data is routed to a Customer destination**
  - Destination specified in the original SSC service request; Customer modifications are supported
  - The Customer address consists of TCP Port number and IP address
  - DAS will support CCSDS telemetry formats that include: IPDU, SFDU (including ACE & AXAF-I), and LEO-T
  - Since DAS is connected to the NISN Closed IOnet, all out-going data is passed through the NISN Secure Gateway for customers not on the Closed IOnet

- **Customers may establish a local interface to DAS at the WSC or GRGT locations**
  - Local interface connections will support TCP/IP/Ethernet protocols

Anomaly Operations

(Example: ICON receives an IBU 'no-go' status)

- IBU alerts ICON [0]; ICON alerts DASCON [1]
- DASCON will automatically assign an unallocated IBU (If available)
- DASCON alerts SWSI and sends an alert to the CTFS SSC [2] which alerts the TOCC operator [3]
- An operator is sent to fault isolate first via DASCON GUI [4]
- The DASCON GUI will indicate a problem that requires ICON GUI [5]
- The operator fault isolates using the ICON [6]
- ICON indicates a faulty IBU which can be hot-swapped [6]



Adding IBUGs and DMGs to Basic Infrastructure

- **IBUG and DMG chassis are 'plug and play' up to:**
  - 8 DMGs (Demod chassis) at each WSGT and GRGT
  - 10 IBUGs at WSGT; 10 IBUGs at GRGT but each requires a separate EMC output set
- **Controllers automatically report presence of operational IBUGs and DMGs**
- **No need for operator to update database**
- **ICONs, DCONs, IBUGs and DMGs have pre-defined IP addresses that facilitate 'plug and play' operation**
  - These IP addresses can be altered from the IBUG and DMG FPDs and from the ICON and DCON GUIs

Expandability to Basic Infrastructure by adding IBUGs and DMGs is a key element of the DAS architecture/design

Day-1 Agenda

1. CDR/DDR Introduction
2. DAS Overview
3. DAS Ops Concept Overview
4. **SWSI Overview**
   - **Background**
   - **Documentation**
   - **SWSI/DAS Interface**
   - **Requirements**
   - **Architecture**
   - **Schedule**
   - **Code Estimates**
   - **Issues**
5. DAS Systems Engineering Summary
6. DAS Verification Planning
7. DAS Design Overview
8. DAS Detailed Hardware Design

SWSI Background

- **Java-based platform independent customer interface to NCCDS for performing TDRSS scheduling and real-time service monitoring and control**
- **Requirements/Design Review (R/DR) held October 19, 2000 presented detailed design of NCCDS interface**
- **SWSI is being expanded to support a DAS customer interface**
  - Goal is integrated customer interface for scheduling, monitoring, and control of all (legacy & DAS) SN services
  - Makes use of infrastructure already under development to support secure standardized interface across all networks (Closed IONet, Open IONet, and Internet)
- **Only changes in SWSI needed to support DAS are covered in this review**

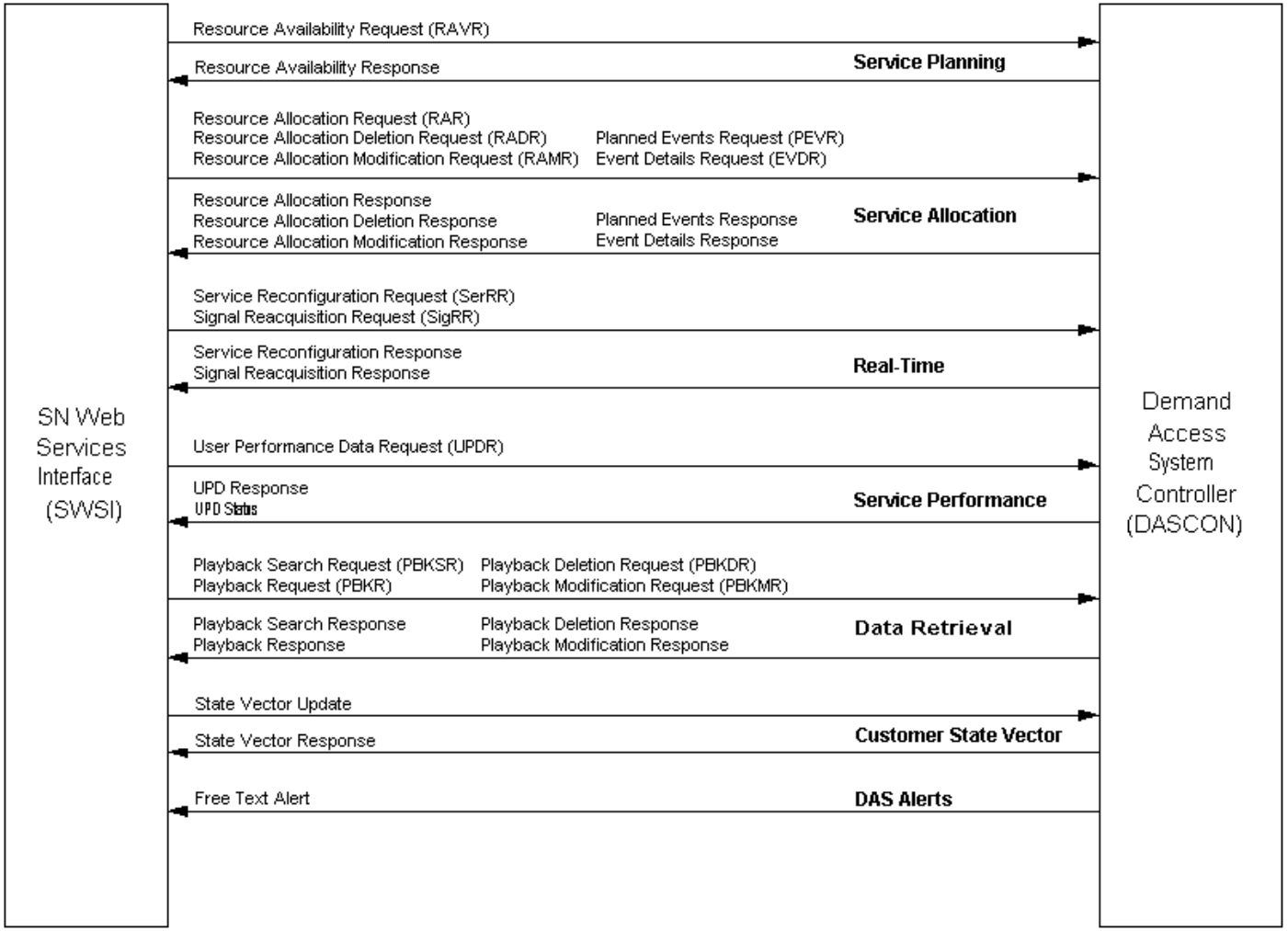
Documentation

- **Draft for review**
  - SWSI System Requirements, 453-SRD-SWSI
  - SWSI System Design Specification, 453-SDS-SWSI
- **Main SWSI web page:**

  http://msp.gsfc.nasa.gov/swsi/
- **SWSI documentation page:**

  http://msp.gsfc.nasa.gov/swsi/docs/docs.htm

SWSI-DAS Interface



SWSI-DAS Interface (Cont'd)

- **All messages exchanged over single TCP connection initiated by SWSI**
- **SWSI/DAS ICD defines high-level message contents. Message details defined by eXtensible Markup Language (XML) schema. Schema may be found through link on SWSI documentation page at:**

  http://msp.gsfc.nasa.gov/swsi/docs/docs.htm
- **Service Specification Codes (SSCs)**
  - Pre-defined sets of service parameter settings
  - Maintained solely on SWSI by the customer
  - Full set of parameters is sent to DASCON in Service Allocation Requests

SWSI-DAS Interface (Cont'd)

- "Active Schedule" maintained on DASCON only. Planned Events Request and Event Details Request messages used by SWSI to query DAS active schedule
- New category of messages for playback planning
- Free text alert messages

New SWSI Requirements

- **DAS Customer Identification, Authentication, & Authorization**
  - Identify & authenticate DAS customers (DAS SRD 3.1.1.a)
  - Report login results within 10 seconds (DAS SRD 3.2.1.a)
  - Restrict DAS customer from modifying other customer requests or accessing other customer data (DAS SRD 3.1.2.3.2.a, 11.4.a)
  - Provide for authorized operator maintenance of DAS authentication & authorization parameters (user IDS, passwords, permission levels, etc) (DAS SRD 3.1.6.f, 3.1.6.g, 3.1.8.3.a, 3.1.8.3.b, 3.1.8.3.f)
- **DAS SSC Maintenance**
  - Allow customers to maintain up to 10 DAS SSCs for each spacecraft (DAS SRD 3.2.1.1.a)

New SWSI Requirements (Cont'd)

- **Service Planning**
  - Allow customer to submit DAS Resource Availability requests and display the results
- **Service Allocation**
  - Allow customer to schedule DAS MAR services via the Resource Allocation Request (RAR)
  - Allow customer to specify default parameter values for a RAR via an SSC code and to overwrite default values for a specific request
  - Allow customer to delete a previously requested or scheduled DAS service
  - Allow customer to modify the service parameters or time period of a previously submitted request
  - Store previously submitted service allocation requests for later viewing
  - Provide for display of both NCCDS schedule requests and DAS service allocation requests in a single display panel

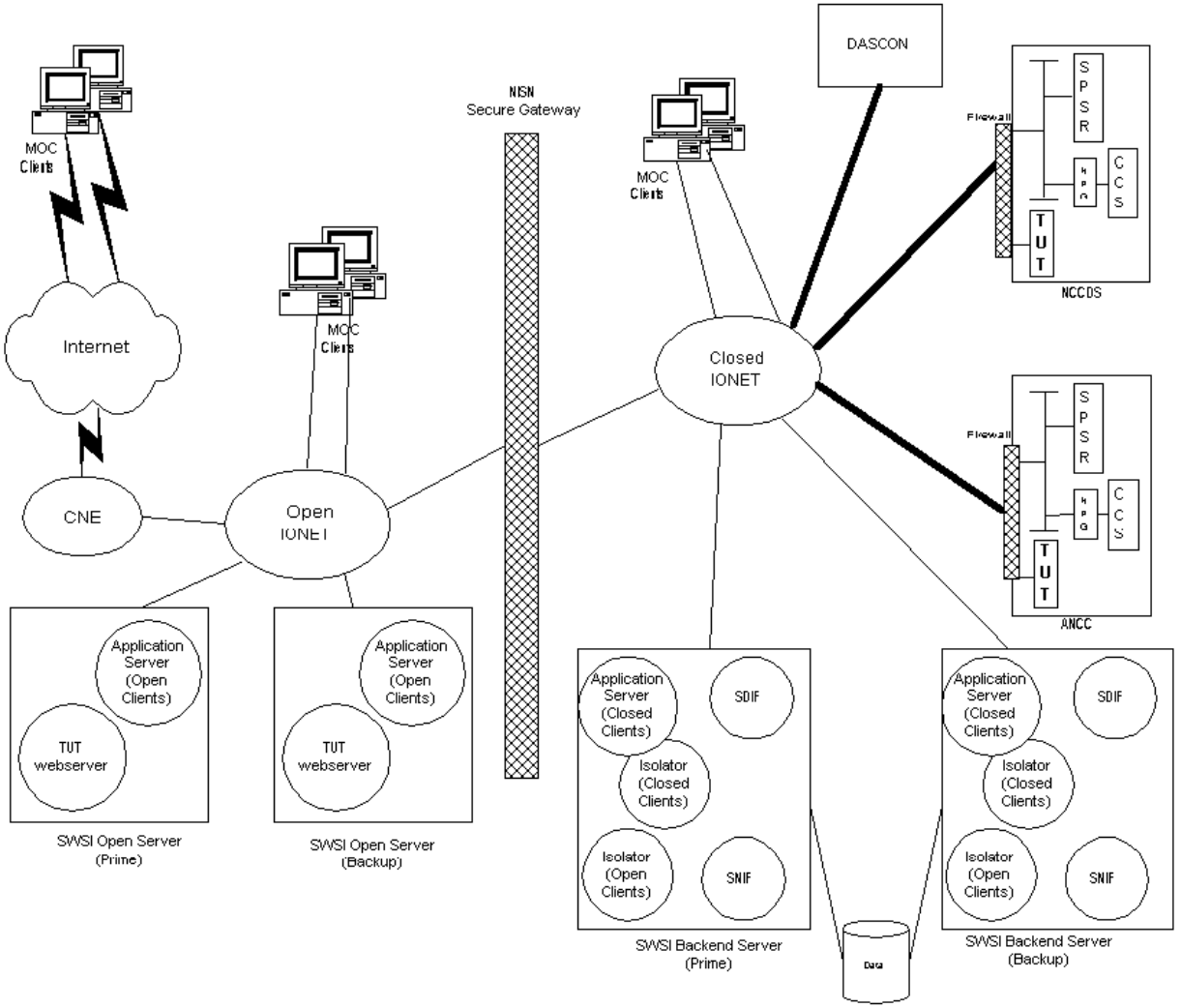
New SWSI Requirements (Cont'd)

- **Active Schedule Display**
  - Display scheduled events for both NCCDS and DAS in a single display panel
  - Allow customer to display details about a DAS MAR event, including a list of TDRS handovers
- **Service Reconfiguration**
  - Allow customer to change the parameters of an ongoing DAS service and display the DAS response
  - Allow customer to submit a Signal Reacquisition Request for an active service and display the DAS response
- **Service Performance**
  - Receive and display DAS User Performance Data (UPD)

New SWSI Requirements (Cont'd)

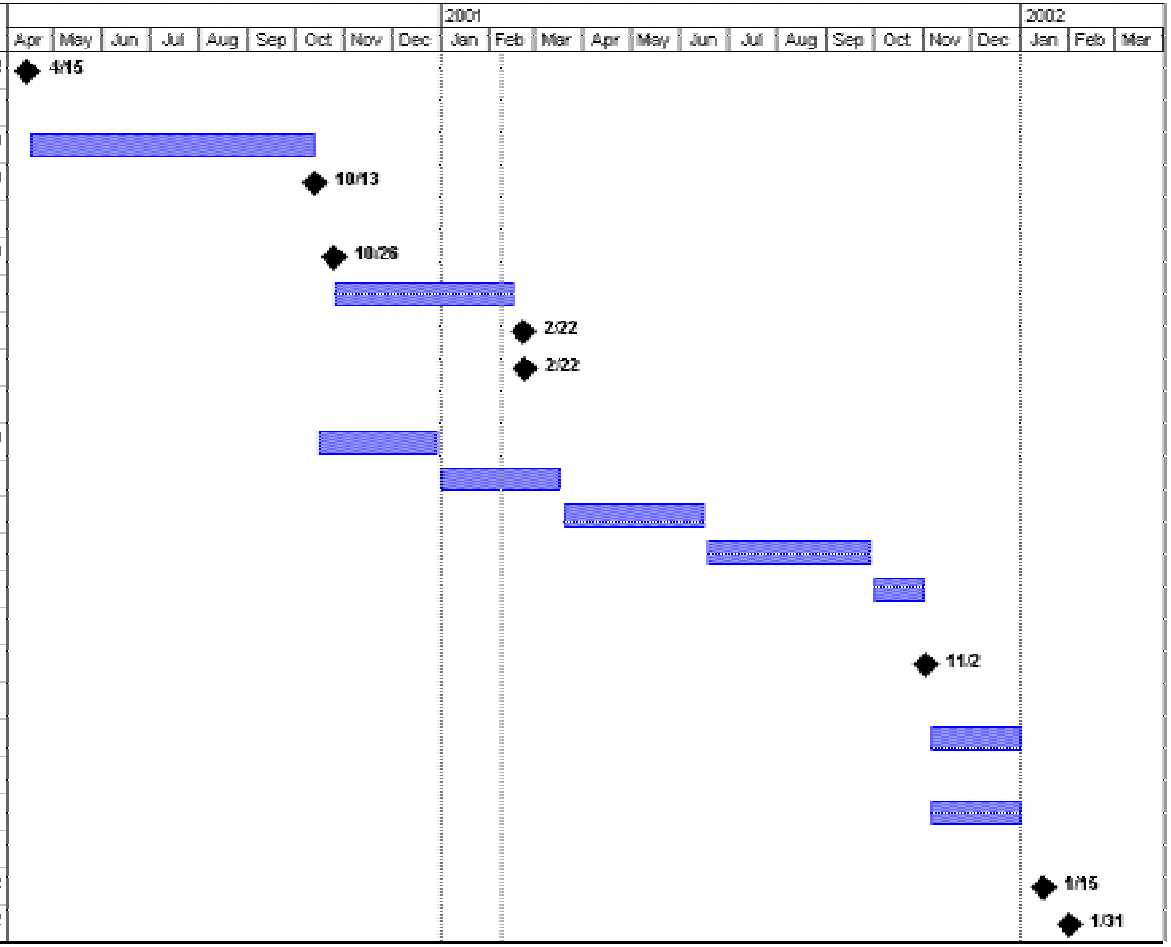
- **Playback Planning**
  - Allow customer to submit DAS Playback Search Request and display the DAS response
  - Allow customer to submit DAS Playback Request and display the DAS response
  - Allow customer to delete a previously submitted Playback Request
  - Allow customer to modify the start time or destination of a previously submitted playback request
- **Customer State Vector Updates**
  - Transmit state vectors submitted by a customer to either NCCDS or DAS or both, depending on whether the spacecraft has been configured for NCCDS and/or DAS support
- **Alerts**
  - Route and display DAS alerts based on SIC. Alerts for a given SIC will be displayed for all logged-in users authorized for that SIC
  - Log all alerts received from DAS

SWSI Architecture



SWSI Schedule

ID	Task Name	Start	Finish
1	**Project Start**	**Sat 4/15/00**	**Sat 4/15/00**
2			
3	NCCDS I/F Detailed Design	Mon 4/17/00	Fri 10/13/00
4	**Requirements/Design Review**	Fri 10/13/00	Fri 10/13/00
5			
6	**DAS PDR**	Thu 10/26/00	Thu 10/26/00
7	DAS I/F Detailed Design	Thu 10/26/00	Thu 2/15/01
8	**DAS CDR**	Thu 2/22/01	Thu 2/22/01
9	**SWSI Delta RDR**	Thu 2/22/01	Thu 2/22/01
10			
11	Build 0 Development & Test	Mon 10/16/00	Fri 12/29/00
12	Build 1 Development & Test	Mon 1/1/01	Fri 3/16/01
13	Build 2 Development & Test	Mon 3/19/01	Fri 6/15/01
14	Build 3 Development & Test	Mon 6/18/01	Fri 9/28/01
15	Release 1 Integration & Test	Mon 10/1/01	Wed 10/31/01
16			
17	**NCCDS Test Readiness Review**	Fri 11/2/01	Fri 11/2/01
18			
19	DAS I/F Acceptance Test	Mon 11/5/01	Mon 12/31/01
20			
21	NCCDS I/F Acceptance Test	Mon 11/5/01	Mon 12/31/01
22			
23	**Operational Readiness Review**	Tue 1/15/02	Tue 1/15/02
24	**Transition to Operations**	Thu 1/31/02	Thu 1/31/02



SWSI Build Schedule (DAS Functionality)

- **Build 2 (6/15/2001)**
  - DAS menu items on main panel
  - Resource Availability
  - Resource Allocation Requests (RAR, RADR, RAMR)
  - Integration of DAS requests into Schedule Request panel
  - DAS GCMR (Service Reconfiguration Request, Signal Reacquisition Request)
- **Build 3 (9/28/2001)**
  - DAS SSC maintenance
  - TDRS handover panel
  - Playback planning
  - DAS UPD
  - State Vectors
  - Integration of DAS events into Active Schedule panel

SWSI Code Estimates

Subsystem	Language	Original Delivered Source Instructions (DSI)	Addtl DSI for DAS I/F	Total DSI
Client	Java	15000	6500	21500
Application Server	Java	6000		6000
Isolator	Java	5000	3500	8500
SNIF	C	5000		5000
SDIF	Java		5000	5000
Total		**31000**	**15000**	**46000**

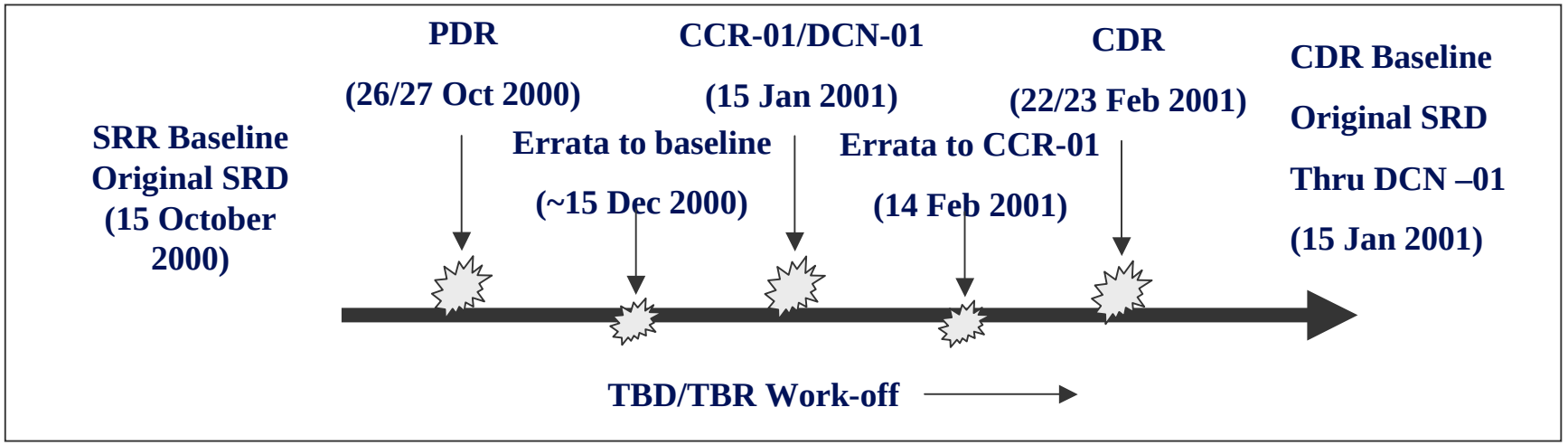
SWSI Issues/Concerns

- **Performance impact of adding DAS interface is unknown**
  - New hardware may be required
  - Performance evaluation to be performed after Build 2 completion (mid-summer)
  - May need to upgrade or replace current hardware

Day-1 Agenda

1. CDR/DDR Introduction
2. DAS Overview
3. DAS Ops Concept Overview
4. SWSI Overview
5. **DAS Systems Engineering Summary**
   - **Key Requirements**
   - **RMA**
   - **ILSP**
6. DAS Verification Planning
7. DAS Design Overview
8. DAS Detailed Hardware Design

Factors Affecting DAS Requirements



- **SRD (through DCN-01 dated 15 Jan 2001) is the new baseline**
  - **All TBDs and TBRs have been resolved**
  - Previous Requirement Issues have resulted in the modification of some requirements.
  - Some changes are not yet fully incorporated in our current design, but we are proceeding according to revised SRD requirements
- **ITT provided Memorandum of Interpretation to state/clarify our understanding of SRD requirements**
  - Minimal impact on either requirements or design

SUMMARY OF KEY REQUIREMENTS CHANGES
(Through DCN-01 of 15 JAN 2001)

❑ RETURN DATA FORMATTING (3.1.5.1.1 & 3.2.5.1.1)

- ➢ WDISC mimicking: CCSDS-related changes to implement IPDU; SFDU (including AXAF-I, ACE,) LEO-T telemetry formats
- ➢ DAS shall support IP data formats for routing to Customers via the NISN Closed IONet or dedicated Customer circuits
- ➢ Modular expandability to support future CCSDS upgrades

❑ RETURN DATA ROUTING (3.1.5.1.2)

- ➢ Requirements modified to reflect real-time and archived data routed to Customer destinations via the NISN Closed IONet or dedicated Customer circuits

❑ DATA STORAGE DURATION and CAPACITY LIMITS

- ➢ 3.1.5.2.2.c – shall automatically remove archived data that has exceeded a defined maximum storage limit
- ➢ 3.2.5.2.1.e & (3.2.5.2.1.f) – Defined max allowable storage duration (capacity limit) shall be changeable at the DAS LCM

❑ RESOURCE ALLOCATION REQUESTS

- ➢ 3.2.2.3.1.d – shall accept resource allocation requests that are to be implemented within 30 seconds after receipt of the request

SUMMARY OF KEY REQUIREMENTS CHANGES
(Through DCN-01 of 15 JAN 2001)

SECTION 11: SECURITY

- **Overview**
  - DAS installed within WSC
  - Interconnected with SWSI and NISN Closed IONet or dedicated Customer circuit
  - Shall conform to NASA NPG 2810.1
- **Security Boundary** as Defined in Security Plans for:
  - SWSI
  - NISN Closed IONet
  - NISN Secure Gateway
  - And, DAS shall be within the Category II Limited Access Area Defined in WSC Security Manual, 530-WSC-0009
- **DAS Interconnections**
  - SWSI
  - NISN Closed IONet
  - NISN Secure Gateway
- **DAS Access**
  - Only authorized Customers have access to their specific Customer data
  - O&M personnel access is controlled as defined in WSC ITSSP, 530-WSC-0024

Requirements
(DAS→SWSI)

- **The following requirements from the DAS SRD are being passed to SWSI for implementation and verification:**

  - 3.1.1.a - The DAS shall process DAS Customer access identification information as part of DAS Logon procedures.
  - 3.1.2.3.2.a - The DAS shall ensure a DAS Customer is restricted from modifying requests submitted by other DAS Customers.
  - 3.1.6.f - The DAS shall accept DAS Customer authentication and authorization parameters from the DAS LCM.
  - 3.1.6.g - The DAS shall report the current DAS Customer authentication and authorization parameters to the DAS LCM.
  - 3.1.8.3.a - The DAS shall allow only authorized personnel to access DAS Customer authentication and authorization data.
  - 3.1.8.3.b - The DAS shall retain DAS Customer authentication and authorization data.
  - 3.1.8.3.f - The DAS shall report the stored Customer authentication and authorization data to authorized personnel only.
  - 3.2.1.a - The DAS shall report the results of a DAS Customer authentication check within 10 seconds of the receipt of the logon request.
  - 3.2.1.1.a - The DAS shall permit each DAS Customer to simultaneously maintain up to 10 resource allocation configuration data sets. (Modified so that the SWSI System Administrator can set number to be maintained)
  - 11.4.a – The DAS shall ensure that only specifically authorized Customers have access to their specific Customer data.

- **The DAS PVM shall reflect that all portions of these requirements will be verified by SWSI. Other requirements, which require both DAS and SWSI to fulfill, will be identified in the PVM, and the portions of the requirement to be verified by each system will be annotated appropriately**

TBD STATUS
(Through DCN-01 of 15 Jan 2001)

ID	Section	Requirement/ Description	Resolution Status	Resolution Date
TBD-1	3.1.5.1.1.a	The DAS shall route Customer data to specified destination(s) in accordance with the DAS to Customer ICD (TBD).	**RESOLVED**	Prior to CDR
TBD-2	3.1.5.1.1.b	The DAS shall route CCSDS compatible return data. (TBD)	**RESOLVED**	Prior to CDR
TBD-3 (was TBR-9)	3.2.1.a	The DAS shall report the results of a DAS Customer authorization check within 10 (TBR) seconds of the receipt of the logon request.	**PASSED to SWSI**	Prior to CDR
TBD-4	3.2.5.1.1.b	The DAS shall support frame sync based CCSDS protocol for routing data to Customers. (TBD)	**RESOLVED**	Prior to CDR
TBD-5	11.0	Section 11. Security	**RESOLVED**	Prior to CDR

Requested Deviations

Dev Nr.	Specification	Summary of Deviation	Status
1	STDN 270.5	Modify racks to comply with manufacturers standard practices	Approved 09/11/00
2	SRD 3.2.4.2.1.8	Limit the symbol/decoder synchronization time requirement to no less than 50 ms.	Submitted 02/13/01
3	SRD 3.2.4.1.12 .a and .b	Reserved	Withheld
4	STDN Spec 3	Programmable Logic will be delivered in SW format	Submitted 02/13/01
5	STDN Spec 3 par 4.2	Self-Adhesive Labels will not be placed on programmable devices	Submitted 02/13/01
6	STDN Spec 3 par 3.0	NASA part numbers will not be assigned to programmable devices	Submitted 02/13/01
7	STDN Spec 8	Selectively Waive compliance w/Spec 8 for parts no longer available	Submitted 02/13/01
8	STDN Spec 4 par 3.4.2	Approve use of 2 components with rack depths greater than 20"	Submitted 02/13/01
9	STDN 270.5	Existing Rack Design does not provide enough power outlets	Submitted 02/13/01
10	STDN Spec 4 par 3.6.1	Delete requirement for elapsed time meter in DAS racks	Submitted 02/13/01
11	SRD 3.1.2.1.b	Modify SRD requirement to require periodic, summarized resource allocation status reports, upon request.	Submitted 02/13/01
12	STDN 270.5	Modify Deviation # 1, additional modifications to DAS racks to meet manufacturer's processes and ventillation requirement	Submitted 02/13/01

Line Replaceable Unit Definition

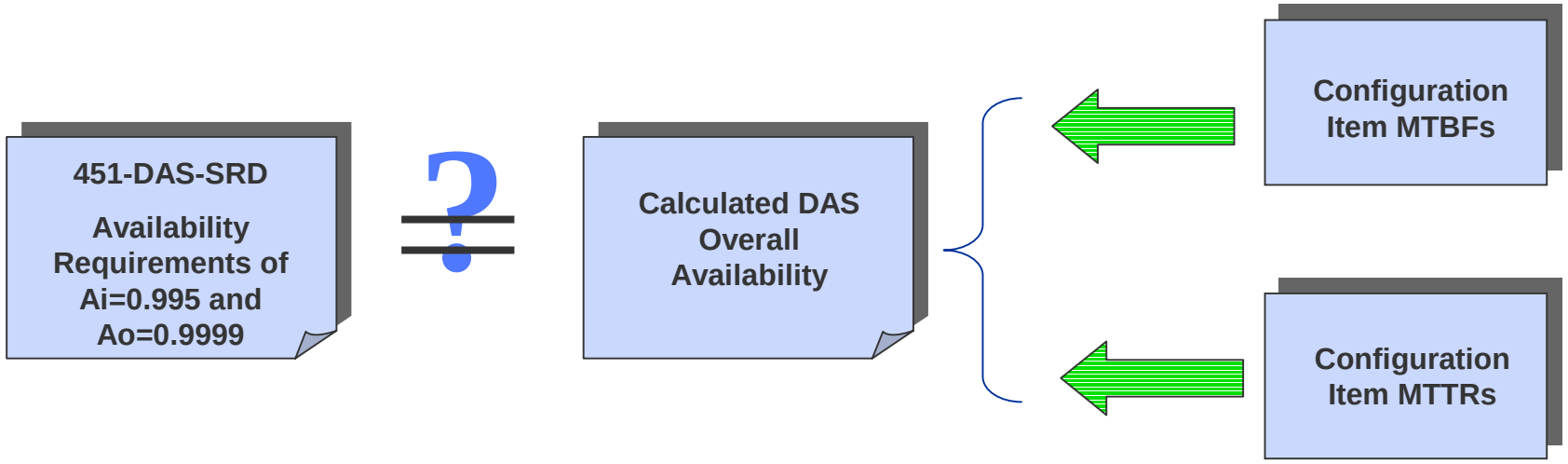
- **Line Replaceable Units (LRUs) have been defined for each Individual Configuration Item**
  - An LRU is defined as a piece of equipment which can be replaced on-site to return the system to its operational capability
  - Redundant implies command switch-over capability
  - Hot Swappable implies replace will not impact operations
- **The LRU list was used to calculate sparing quantities**
- **The LRU List will be finalized prior to final design baseline at TRR**

Configuration Item	Line Replaceable Unit*	
EMC Interface	• Control Processor • Fiber Optic Switch • Fan • Power Supply ®	• Common Data Broadcast • NTS Chassis • Serial Port Card
IBUG ®	• Control Processor • IBU Card ® Power Supply ®	• Fiber Channel Receiver Card • Chassis • Fan
IF Switch	• IF Switch	
DMG ®	• Control Processor • Chassis • Fan	• DMU Card ® • Power Supply ®
Frequency and Timing	• Pulse Distribution Assembly	• Switch and Distribution Unit
ICON	• Server Assembly • Ethernet Hub	• Power Supply ®
DCON	• Server Assembly • Ethernet Hub	• Power Supply ®
DASCON	• Server Assembly • Power Supply ®	• RAID 1 Drive ® • Ethernet Hub
Data Formatter/ Archive Server	• Server Assembly • Power Supply ®	• RAID 1 Drive ® • Ethernet Switch
Mechanical and Power	• Temperature Monitor	

* ® = Redundant
  = Hot Swappable

RMA Prediction

- An RMA Prediction was initially performed to determine the ability of the DAS design to meet the availability requirements of 0.995 for inherent and 0.9999 for operational availability



RMA Prediction Methodology

- **The system availability prediction was calculated using the procedures outlined in the DAS Specification, 451-DAS-SRD**
  - MTBF values for each CI/LRU were calculated using MIL-HDBK-217F for the Ground Benign Environment at 25ºC
    - Vendor data was substituted whenever possible
    - In several instances, limited reliability data required engineering assumptions
  - Revised MTTR values were used
    - Fault Isolation time was limited to the Mechanical and Power CI and was assumed to be one (1) hour

Revised RMA Prediction Results

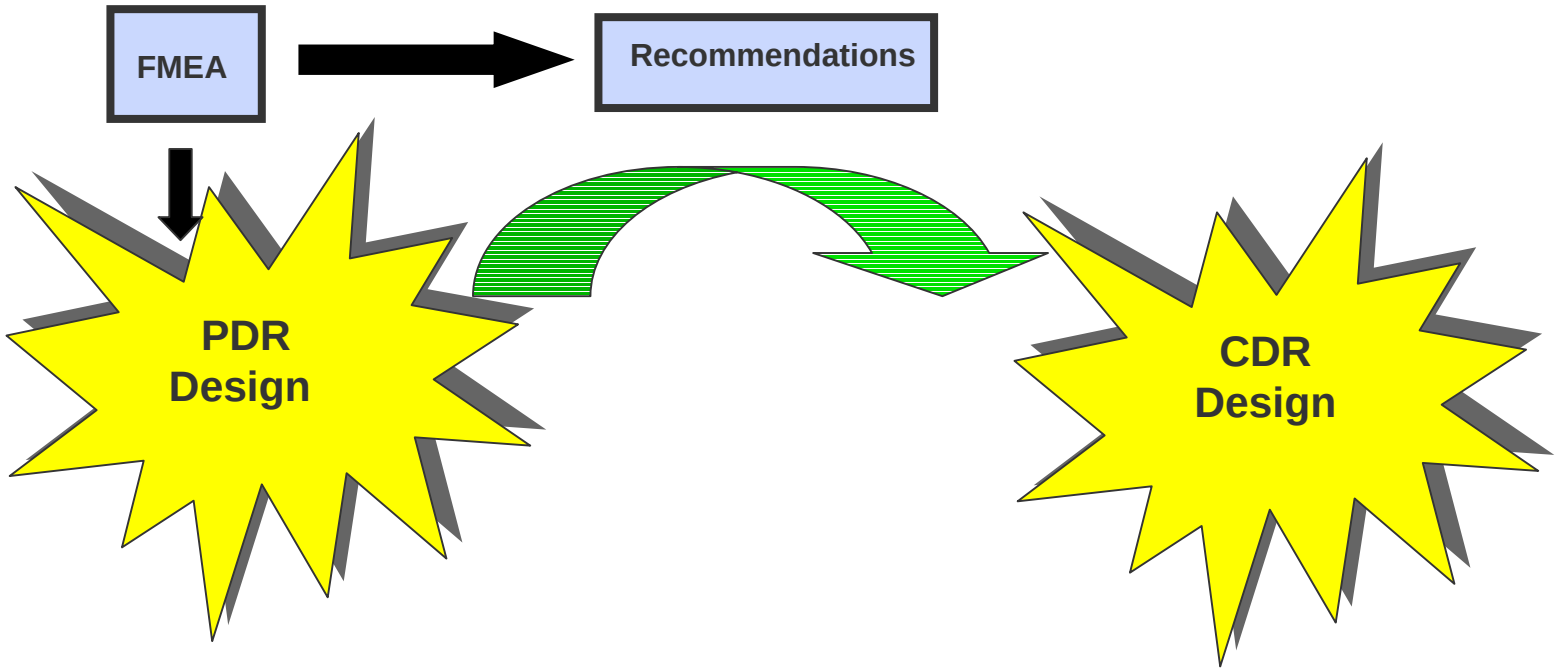
- **GRGT and WSGT meet Inherent Availability Requirements**
- **GRGT meets Operational Availability Requirement**
- **Because WSGT design complexity is greater, Operational Availability is slightly less than required**
- **ITT Assessing WSGT Op Availability – Possible Deviation being considered**

Availability	Requirement	WSGT	GRGT
Inherent	0.995	0.9996	0.9997
Operational	0.9999	0.9998	0.9999

- **Any one of these design modifications will improve Operational Availability**
  - Add redundant fans in the EMC Interface and DASCON server, or
  - Add a redundant DASCON, or
  - Add a redundant Data Formatter/Archive Server, or
  - Add a redundant EMC Interface
- **Ao of 0.9998 = 1.8 hours down time per year;**
  Ao of 0.9999 = 0.9 hours down time

Failure Modes Effects Analysis (FMEA)

- An update to the FMEA was performed to verify mitigation of identified failure modes



Revised FMEA Methodology

- **Each identified failure mode was reviewed with the appropriate CI Lead to determine mitigation**
  - Elimination/Reduction of Failure Mode Severity
    - Invalid Failure Mode/Deletion
    - Design Change
  - Correction of Failure Mode
    - Detection and Error Reporting
  - Program Management Acceptance of Failure Mode

FMEA Category Definitions

- The FMEA categories are defined as follows:

Category	Description	Mishap Definition
I	Catastrophic	Loss of DAS and adverse impact to external/interfacing system components
II	Critical	Loss of DAS or Message (Customer data stream)
III	Marginal	Degradation of DAS
IV	Negligible	Unscheduled Maintenance or Repair, Inconvenience only

Revised FMEA Results

- **Of the 736 potential failure modes identified and reviewed within the DAS design, each has been assessed, mitigated or determined to have a very low probability of occurrence**
  - **393** potential failure modes have been deleted or probability of occurrence is improbable
    - Failure Mode could not occur based on analysis by the CI engineering team
  - **87** potential failure modes have been deleted as a result of design changes
    - Addition of redundant hardware
  - **195** potential failure modes are detected and automatically corrected
  - ~~**675** total potential failure modes closed~~
  - **61** potential failure modes in categories II - IV remain open pending review by CI leads
    - Program Management review performed
    - Design has sufficient mitigation to ensure low probability of occurrence
      - Potential design improvements still being assessed

FMEA Detailed Results and Conclusion

CI/Component	Open				Closed
	Cat I	Cat II	Cat III	Cat IV	
DAS System	***0***	***16***	***38***	***7***	***675***
EMC Interface	0	0	0	0	60
IBUG	0	0	0	0	114
IF Switch	0	3	1	0	102
DMG	0	0	0	0	103
Frequency and Timing	0	1	2	0	55
ICON	0	1	5	0	62
DCON	0	4	7	0	47
DASCON	0	5	18	0	79
Data Formatter/Archive Server	0	2	3	0	53
Mechanical and Power	0	0	2	7	0

- Each of the Category II findings will remain open and will be tracked until evidence can be provided to indicate that the reliability risk has been mitigated

System Safety Evaluation

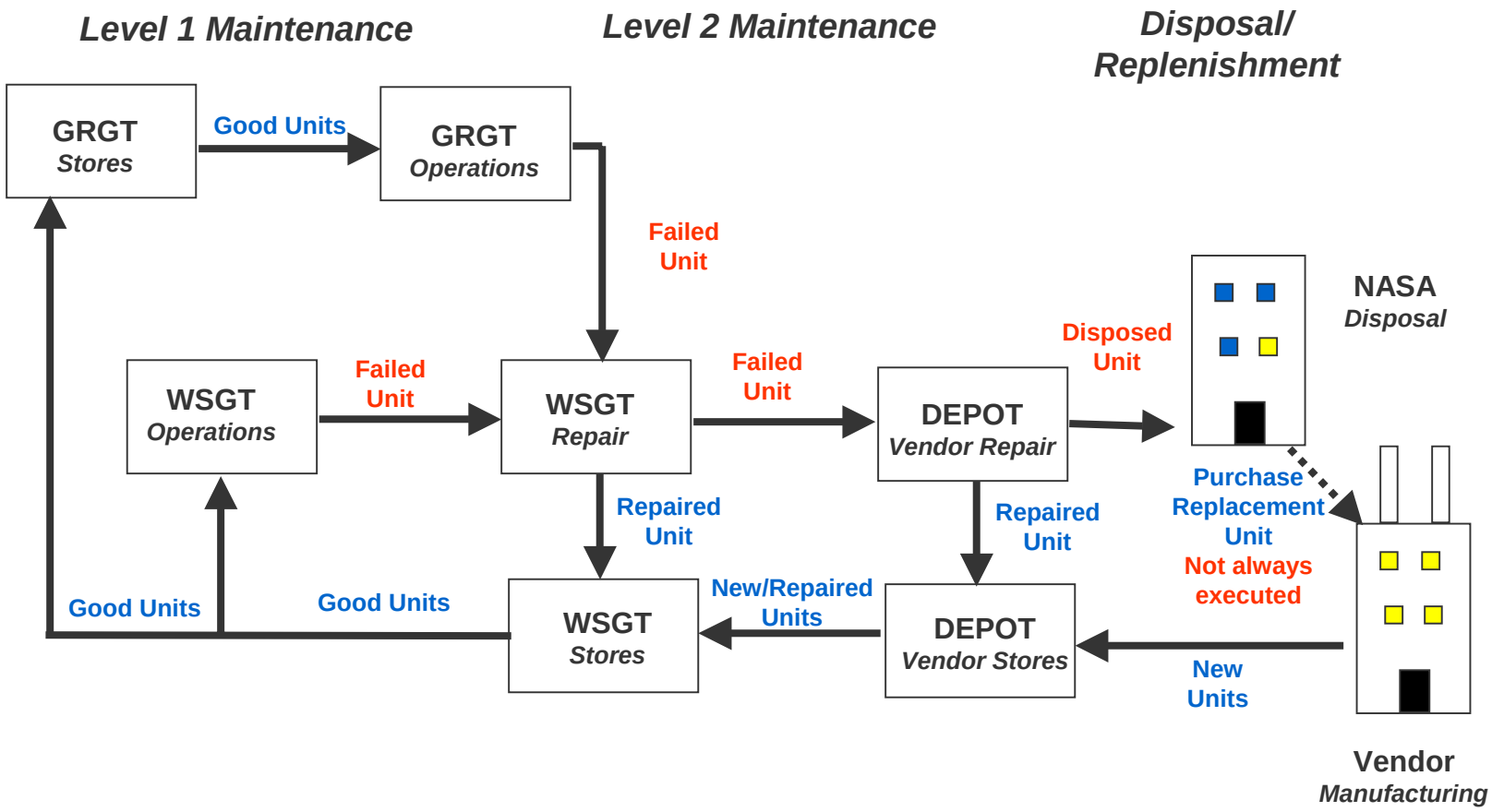
- **An evaluation was performed to identify, during normal system operation, potential failure modes that would result in a safety hazard**
  - The current design was reviewed for hazards identified from analyses on similar programs

- **No significant hazards were identified**
  - Use of hazard labels - Two Person Lift, High Voltage, etc

Integrated Logistic Support (ILS)

- **A Revised ILS Plan (ILSP) was generated to define the programmatic and management structure to be used on the DAS Program**
  - Establishes responsibilities across organizations
  - Defines the maintenance concept
  - Identifies the Field-Replaceable components
  - Identifies the Operational information required to evaluate spare quantities
  - Lists the spare quantities and locations
    - For initial deployment
    - For final deployment

DAS Maintenance Concept



DAS Initial Sparing Quantities and Allocation

CI / LRU	Red. x of y	LRU Quantity	MTBF (hours)	Total Spare Quantity	WSGT Stores	GRGT Stores	Depot
Beamformer (IBUG) CI	3						
Control Processor	1 1	3	190,500	**1**	1		
IBU Card	6 6	18	56,547	**1**	1		
Fiber Channel Receiver Card	1 1	6	88,313	**1**	1		
Chassis	1 1	3	111,212	**1**	1		
Power Supply	1 2	6	110,257	**1**	1		
Fan	1 1	3	31,464	**2**	1	1	
Demodulator Group (DMG) CI	2						
CP	1 1	2	190,500	**1**	1		
DMU Card	8 8	16	38,825	**3**	2	1	
Chassis	1 1	2	85,372	**1**	1		
Power Supply	1 2	4	110,257	**1**	1		
Fan	1 1	2	31,464	**1**	1	1	
EMC Interface CI	1 1						
CDB Switch	1 1	1	304,182	**1**	1		
Power Supply Assembly	1 2	2	110,257	**1**	1		
Fan Assembly	1 1	1	25,000	**1**	1		
Serial Port Card	1 1	1	166,667	**1**	1		
Control Processor	1 1	1	190,500	**1**	1		
Fiber Optic Switch	2 2	2	14,854	**4**	4		
Frequency and Timing CI	1 1						
Switch and Distribution Unit	1 1	2	282,461	**1**	1		
Pulse Distribution Assembly	1 1	2	50,000	**1**	1		
IF Switch CI	1 1						
IF Switch	1 1	2	125,000	**1**	1		

DAS Initial Sparing Quantities and Allocation (Cont'd)

CI / LRU	Red. x of y	LRU Quantity	MTBF (hours)	Total Spare Quantity	WSGT Stores	GRGT Stores	Depot
IBUG Controller (ICON) CI	1 1						
450 MHz Server Assembly							
Computer	1 1	2	17,646	**3**	1	1	1
Power Supply	1 2	4	200,000	**1**	1		
Ethernet Hub (FastHub 412)	1 1	2	244,007	**1**	1		
Demodulator Controller (DCON) CI	1 1						
450 MHz Server Assembly							
Computer	1 1	2	17,646	**3**	1	1	1
Power Supply	1 2	4	200,000	**1**	1		
Ethernet Hub (FastHub 412)	1 1	2	244,007	**1**	1		
DAS Controller (DASCON) CI	1 1						
600 MHz Server Assembly							
Computer	1 1	1	16,620	**2**	2		
RAID 1 Drive	1 2	2	400,000	**1**	1		
Power Supply	1 2	2	200,000	**1**	1		
Ethernet Hub (FastHub 412)	1 1	1	244,007	**1**	1		
Data Formatter/Archive Server CI	1 1						
600 MHz Server Assembly							
Computer	1 1	2	16,620	**4**	2	2	
RAID 1 Drive	1 2	4	400,000	**1**	1		
Power Supply	1 2	4	200,000	**1**	1		
Ethernet Switch (24-port Switch)	1 1	2	304,182	**1**	1		
Mechanical and Power CI	1 1						
Temperature Monitor	1 1	2	435,000	**1**	1		

Planning assumptions:
1) Initial DAS configuration consists of three IBUGs (two at WSGT and one at GRGT) and two DMGs
2) LRU Quantity includes combined quantities of GRGT and WSGT (GRGT does not have EMC Interface or DASCON)

DAS Final Sparing Quantities and Allocation

CI / LRU	Red. x of y	LRU Quantity	MTBF (hours)	Total Spare Quantity	WSGT Stores	GRGT Stores	Depot
Beamformer (IBUG) CI	20						
Control Processor	1 1	20	190,500	**1**	1		
IBU Card	6 6	120	56,547	**1**	1		
Fiber Channel Receiver Card	1 1	40	88,313	**1**	1		
Chassis	1 1	20	111,212	**1**	1		
Power Supply	1 2	40	110,257	**1**	1		
Fan	1 1	20	31,464	**8**	4	4	
Demodulator Group (DMG) CI	16						
CP	1 1	16	190,500	**1**	1		
DMU Card	8 8	128	38,825	**17**	4	4	9
Chassis	1 1	16	85,372	**1**	1		
Power Supply	1 2	32	110,257	**1**	1		
Fan	1 1	16	31,464	**7**	4	3	
EMC Interface CI	1 1						
CDB Switch	1 1	1	304,182	**1**	1		
Power Supply Assembly	1 2	2	110,257	**1**	1		
Fan Assembly	1 1	1	25,000	**1**	1		
Serial Port Card	1 1	1	166,667	**1**	1		
Control Processor	1 1	1	190,500	**1**	1		
Fiber Optic Switch	2 2	2	14,854	**4**	4		
Frequency and Timing CI	1 1						
Switch and Distribution Unit	1 1	2	282,461	**1**	1		
Pulse Distribution Assembly	1 1	2	50,000	**1**	1		
IF Switch CI	1 1						
IF Switch	1 1	2	125,000	**1**	1		

DAS Final Sparing Quantities and Allocation (Cont'd)

CI / LRU	Red. x of y	LRU Quantity	MTBF (hours)	Total Spare Quantity	WSGT Stores	GRGT Stores	Depot
IBUG Controller (ICON) CI	1 1						
450 MHz Server Assembly							
Computer	1 1	2	17,646	**3**	1	1	1
Power Supply	1 2	4	200,000	**1**	1		
Ethernet Hub (FastHub 412)	1 1	2	244,007	**1**	1		
Demodulator Controller (DCON) CI	1 1						
450 MHz Server Assembly							
Computer	1 1	2	17,646	**3**	1	1	1
Power Supply	1 2	4	200,000	**1**	1		
Ethernet Hub (FastHub 412)	1 1	2	244,007	**1**	1		
DAS Controller (DASCON) CI	1 1						
600 MHz Server Assembly							
Computer	1 1	1	16,620	**2**	2		
RAID 1 Drive	1 2	2	400,000	**1**	1		
Power Supply	1 2	2	200,000	**1**	1		
Ethernet Hub (FastHub 412)	1 1	1	244,007	**1**	1		
Data Formatter/Archive Server CI	1 1						
600 MHz Server Assembly							
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Power Supply	1 2	4	200,000	**1**	1		
Ethernet Switch (24-port Switch)	1 1	2	304,182	**1**	1		
Mechanical and Power CI	1 1						
Temperature Monitor	1 1	2	435,000	**1**	1		

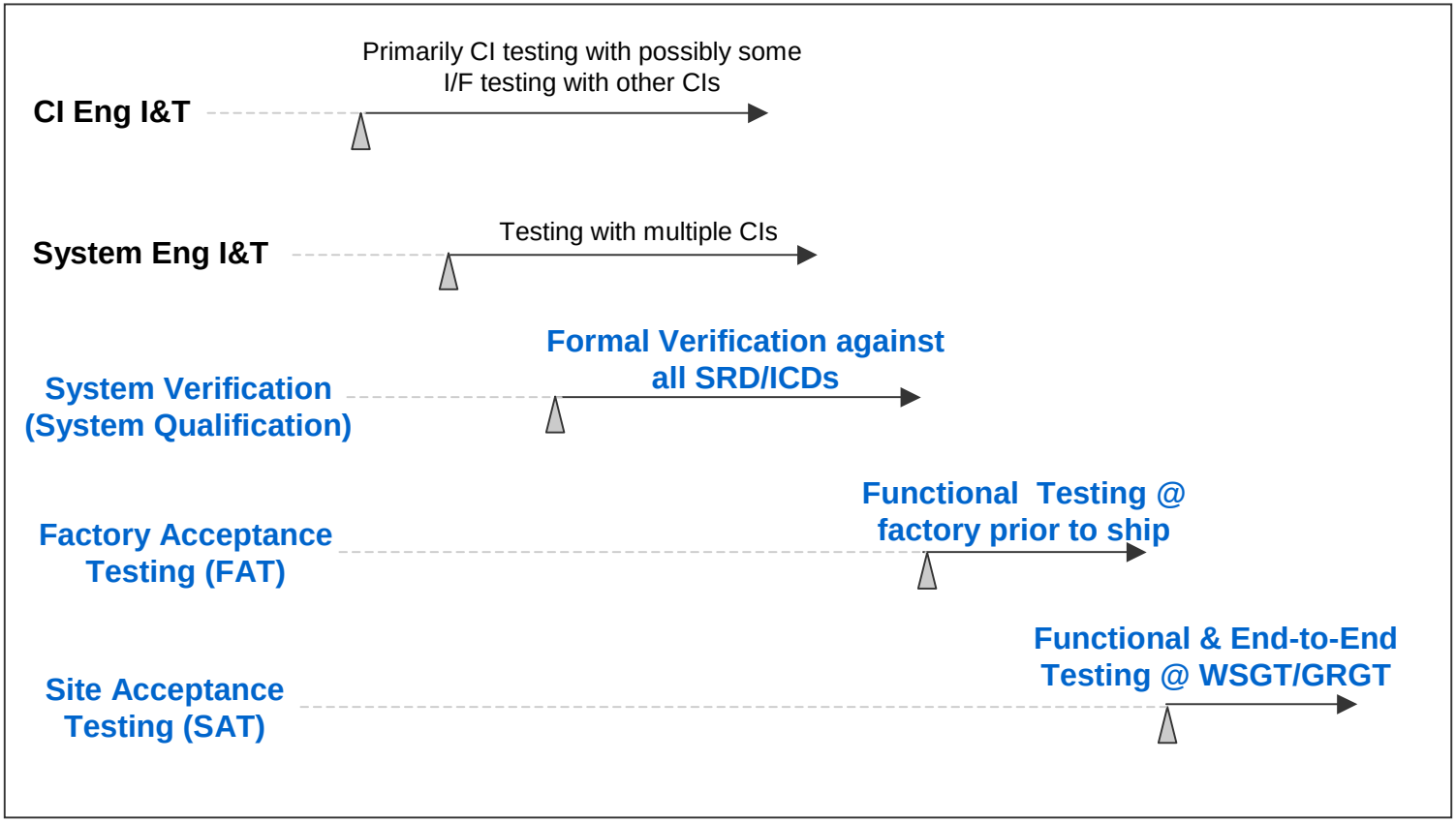
Planning assumptions:
1) Initial DAS configuration consists of three IBUGs (two at WSGT and one at GRGT) and two DMGs
2) LRU Quantity includes combined quantities of GRGT and WSGT (GRGT does not have EMC Interface or DASCON)

Day-1 Agenda

1. CDR/DDR Introduction
2. DAS Overview
3. DAS Ops Concept Overview
4. SWSI Overview
5. DAS Systems Engineering Summary
6. **DAS Verification Planning**
   - **Verification Planning Overview**
   - **Inspection / Analysis Cases**
   - **Emulators**
   - **Test Cases**
7. DAS Design Overview
8. DAS Detailed Hardware Design

Test & Verification

Overview



DRL-11
Test Plan Document Schedule

DRL-11 Volume	Title	Draft	Final	Comment
I	Test Plan	2/15/01 [*]	5/21/01 [*]	- Verifies all SRD requirements - Describes all Verifcation Cases: - - Analysis, Inspection and Test/Demo Cases
II	Test Procedures	7/3/01 [*]	8/28/01 [*]	- Details all System Verification test procedures - Provides 'Step by Step' description - Identiifies specific success criteria
III	Factory Acceptance Test Plan	11/12/01	12/12/01 (DAS TRR)	- Provides plans and procedures - Represents functional testing of DAS at Reston Factory - Tests 'Production' DAS prior to ship
IV	Site Acceptance Test Plan	12/23/01	1/23/02 (Jan MSR)	- Provides plans and procedures - Represents functional and end-to-end testing

- **Final System/Subsystem Test Plan is due 90 days after CDR**
- **Results presented at CDR represent current draft-status of Test Plan**

[*] means it is on formal schedule; otherwise it is represents ITT's 'proposed schedule'

Milestones/Schedule

Focus of Test Planning for CDR →

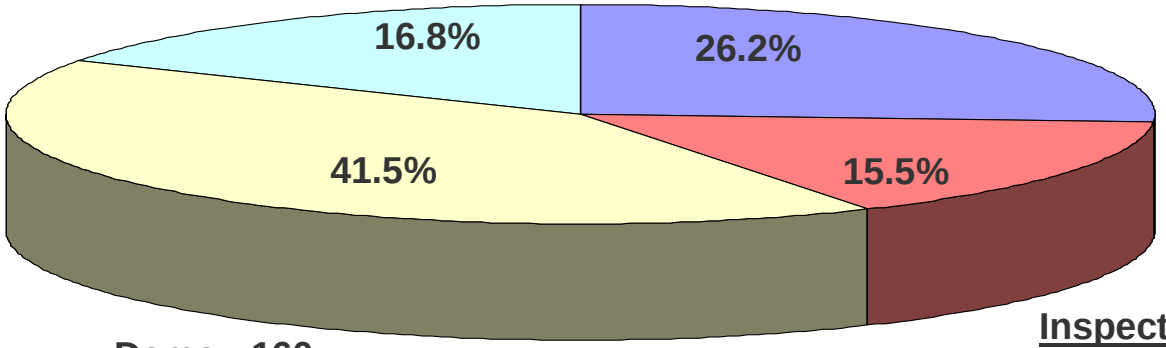
Blue font indicates activity formalized on program schedule

Milestone/ Activity	Schedule	Associated ATP Volume (DRL-11)	Objectives/Rationale
Informal TRR for System Design Verification	Sept/01 MSR		Establishes all baselines and confirms CM status for all HW, SW and engineering drawings; also reviews all Analysis and Inspection Case results
System Design Verification	9/25/01 - 12/31/01 (70 days)	Vol I and Vol II - Plan + Procedures	Verifies design against all SRD and ICD requirements
Test Results and Discrepancy Review	Oct/01 MSR		Provides status of ongoing testing and of resolution of discrepancies
Test Results and Discrepancy Review	Nov/01 MSR		Provides status of ongoing testing and of resolution of discrepancies
DAS TRR	12/12/2001		Establishes all baselines and confirms CM status for all HW, SW and engineering drawings
Test Results and Discrepancy Review	Dec/01 MSR		Provides status of ongoing testing and of resolution of discrepancies prior to FAT
Factory Acceptance (FAT)	1/3/02 - 1/28/02 (18 days)	Vol III - Plan + Procedures	Performs functional testing to verify fabrication, assembly and integration
Informal Pre-Ship Readiness Review	Jan/02 MSR		Reviews resolution status of all Discrepancy Reports and status of FAT
Site Acceptance (SAT) **- WSGT** **- GRGT** **- End-to-End**	2/12/02 - 3/29/02 2/12/02 - 2/18/02 3/07/02 - 3/13/02 3/25/02 - 3/29/02	Vol IV - Plan + Procedures	Functional Testing to verify: - Installation - External site interfaces - End-to-End system functionality

Requirements/Verification Overview

Test - 66
- Demodulation
- Archiving
- Customer Interaction

Analysis - 101
- Signal Distortions
- RMA
- Training
- Maintenance



Demo - 160
- Most Functional Reqmts (SRD 3.1)
- Most Performance Reqmts (SRD 3.2)

Inspection - 60
- Beamforming
- Design & Construction
- Training
- Sparing
- Security

Total Requirements = 386

System Qualification

- **To the extent possible System Verification (or 'System Qualification') against all DAS SRD requirements will be complete prior to 'Production' DAS FAT and shipping (Jan/Feb 2002)**

- **Two EMI Requirements (SRD Section 5.4) will be verified after deployment:**
  - 5.4.f: DAS equipment shall not be affected by conducted or radiated emissions resulting from the operation of existing equipment
  - 5.4.h: DAS equipment conducted or radiated emissions shall not affect existing equipment

- **Risk Mitigation**
  - All DAS equipment shall comply to at least FCC Class A EMI constraints
  - DAS employs NASA 270.5 EMI Racks
  - Good EMI design practices employed (e.g., Honeycomb waveguide vents)
  - IBUGs previously tested to 'tougher' MIL-STD-461c; DMG and FO Switch have similar design characteristics

Testing for 50 Users

- **Initial equipage insufficient to directly test for 50 users**
- **Will verify capability using combination of analysis, demonstration and test**
  - IBUG – Demo to verify capacity to handle six IBUs
  - DMG – Demo to verify capacity to handle eight DMUs
  - PTP – Demo to verify capacity to handle 25 streams
  - F.O. Switch – Analysis to verify capacity to support 10 IBUGs
  - IF Switch – Analysis to verify capacity to support 50 IBUs and 50 DMUs
  - ICON – Demo to verify support of 18 IBUs plus analysis of capacity of support 50; key criteria – ability to generate 50 simultaneous near real-time direction cosines continuously
  - DCON – Demo to verify support of 16 DMUs plus analysis of capacity to support 50; key criteria – ability to generate 50 simultaneous near real-time Doppler corrections continuously

Analysis Cases (101 Requirements)

Analysis Case	SRD Reference Paragraph	Analysis Title	Associated Inspection Cases	Associated Test Cases
1	3.1.9	Modular Expansion		T4
2	3.2.2.4	Vector Data Management		T4
3	3.2.4.2.1.2, 3.2.4.2.1.6.o, 3.2.4.2.1.13, 3.2.4.2.1.14	RFI and Signal Distortions		
4	3.2.4.2.1.8, 3.2.4.2.1.9, 3.2.4.2.1.10, 3.2.4.2.1.12	Bit Slip and Sync		
5	3.2.4.2.1.11, 3.2.4.2.1.16	False Acq and Reacq		
6	3.1.5.2.2.a, 3.2.5.1.4, 3.2.5.2.1, 3.2.7.1.h	Return Data Handling		T4
7	4.1, 4.2, 4.3, 4.4	RMA		T4
8	8.1, 8.2	Training	I6	
9	9.2	Maintenance		
10	10.1.c, 10.3.b	Sparing	I7	

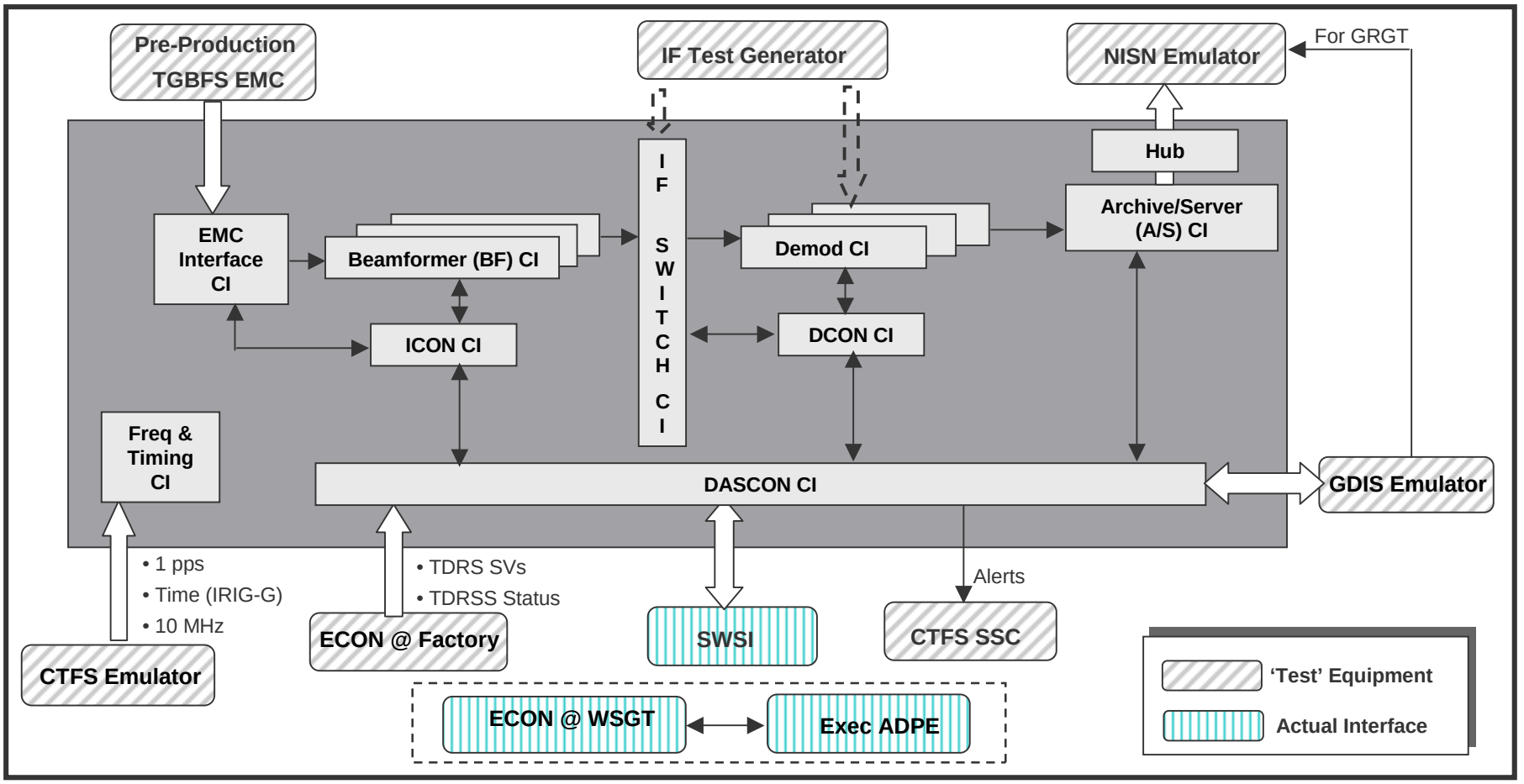
Analysis Cases consistent with SRD PVM

Inspection Cases (60 Requirements)

Inspection Case	SRD Reference Paragraph	Inspection Title	Associated Analysis Cases	Associated Test Cases
1	3.1.3, 3.2.3	Beamforming		
2	3.1.7.1.g	Status Indicators		
3	5.1, 5.2, 5.3	Design and Construction		
4	5.4c, 5.4.d	EMI		T11, T12
5	6.1, 6.2, 6.3	Installation		
6	8.1, 8.2, 8.3, 8.4, 8.5, 8.6	Training	A8	
7	10.1,10.3, 10.4	Sparing	A10	
8	11	Security		
9	12	Human Eng and Safety		

Inspection Cases consistent with SRD PVM

Emulators/Interfaces



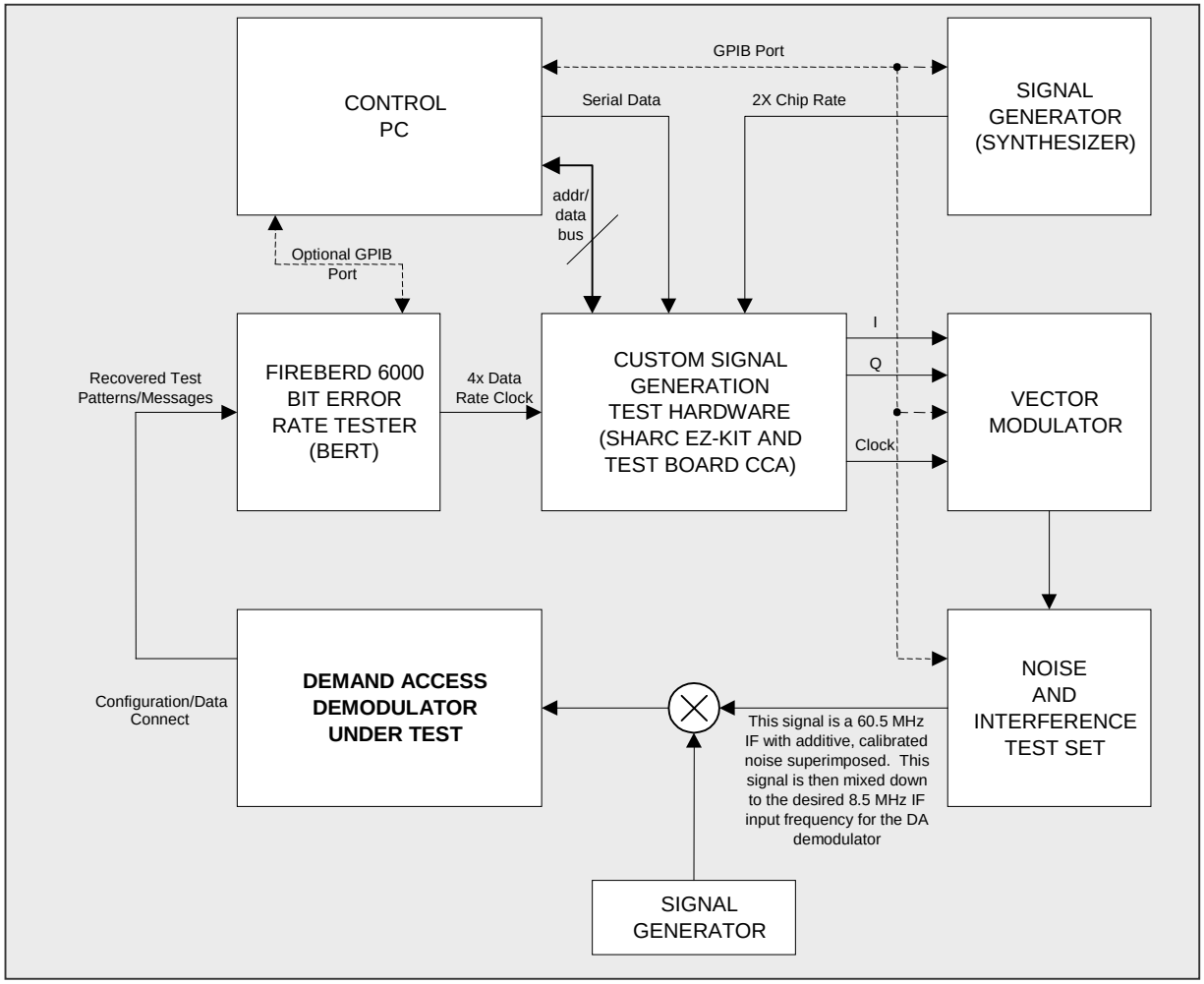
Note: System Verification occurs (Fall 2001) prior to end-to-end testing (Spring 2002) so that emulators are required to verify/test interfaces

Emulator Assessment

Item	Description	Comments on Formal Verification
CTFS Emulator	- COTS IRIG-G Generator - Custom board to convert to RS422 - Provides IRIG-G and 1 pps	Provides the identical signal to that provided by the CTFS so that can be use in formal verification testing as appropriate
EMC Emulator (TGBFS P/P EMC)	- Preproduction Model built under TGBFS - Same Output and I/Fs as Production EMCs at WSC - Allows for multiple copies for testing EMC I/F CI	In EMC 'Data Generator' test mode can only generate a CW signal so adequate to verify EMC I/F CI and Beamformer CI but not DMG nor DSER
IF Signal Emulator (IF Test Generator)	- Combination of COTS and custom boards - Provides entire range of signalling parameters - Currently cannot simulate Doppler on the signal - Provides signal at 8.5 MHz IF ('after beamformer')	Significant characterization and testing of the demod can be performed. However will need to verify Doppler aspects related to the Demod at WSC
NISN Emulator	- Consists of NIC card and a PC - Does not address WDISC formatting	Provide sufficient emulation of the NISN I/F that formal verification testing as appropriate can be conducted
ECON Emulator (Factory ECON)	- ITT has updated the ECON to support DAS - This ECON is the same as that deployed for WSC - TDRS SV will be entered manually vs the Exec ADPE I/F	Readily supports formal verification testing
GDIS Emulator	- Consists of routers to emulate the DAS I/F's with GDIS - Will connect DAS components on 'other side' of router from DASCON	DAS does not need to verify GDIS operation so that this should be sufficient for formal verification
CTFS SSC Emulator	- Will use emulator just as done on TGBFS - Straightforward to implement	Require the use of CTFS SSC Alert for verification testing as appropriate
SWSI	**- This interface is too complex to build emulator - Will need to use SWSI itself - Intend to verify with SWSI at GSFC**	**Require the use of SWSI for verification testing as appropriate**
EXEC ADPE	**- Will use actual EXEC ADPE - ECON I/F itself - Intend to verify with EXEC ADPE - ECON I/F at WSC**	**Require the use of actual EXEC ADPE - ECON I/F for verification testing as appropriate**

Use Actual I/F for verification

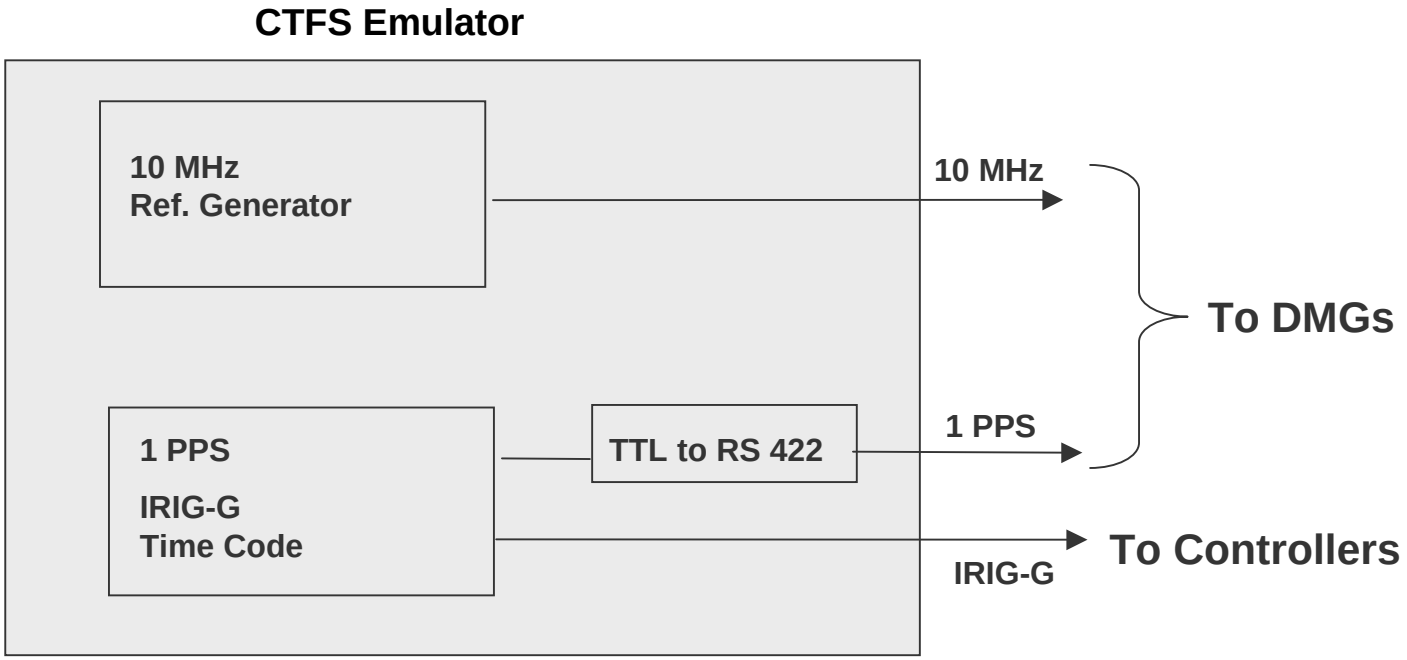
IF Generator (IFG) Description



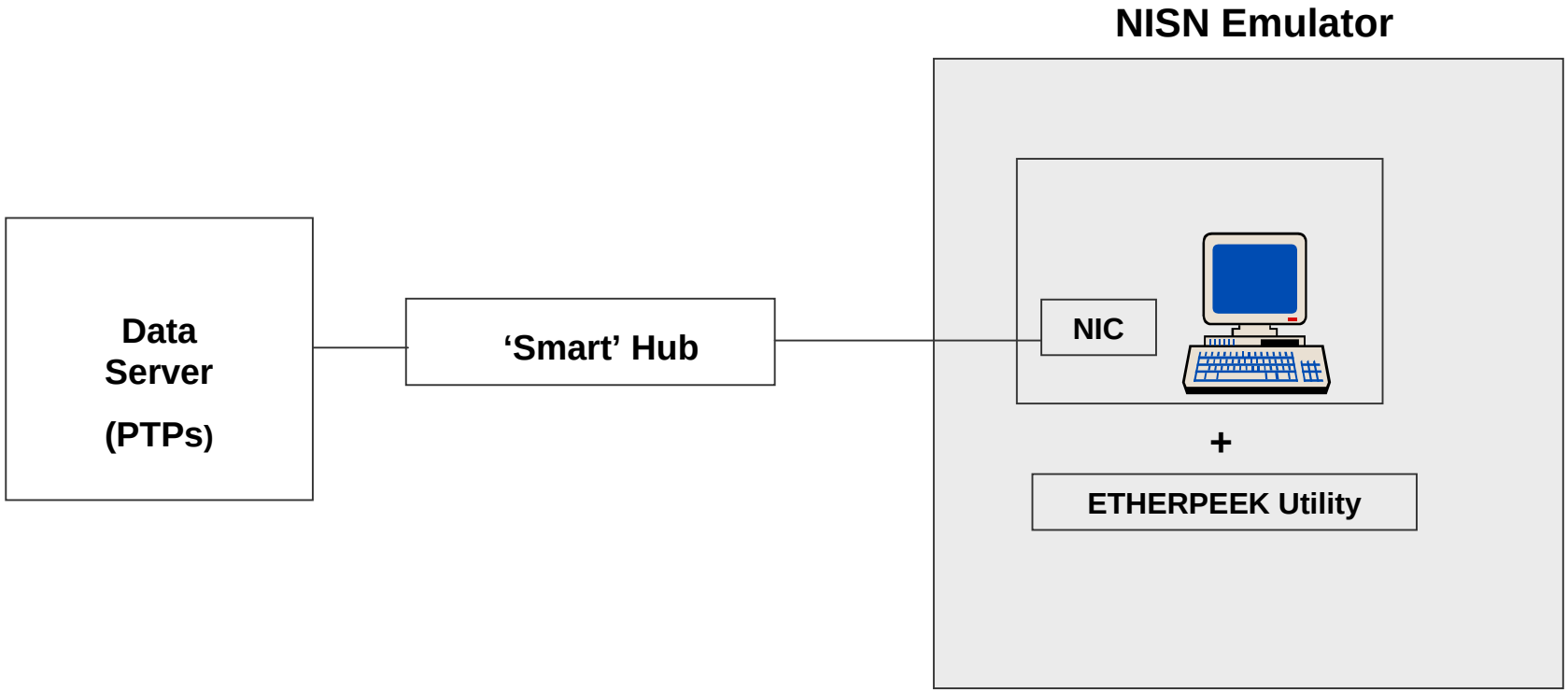
Notes:

- **Allows for detailed acquisition and BER performance testing**
- **Provides a 8.5 MHz IF signal**
- **Does not emulate Doppler (which will be tested at WSGT)**

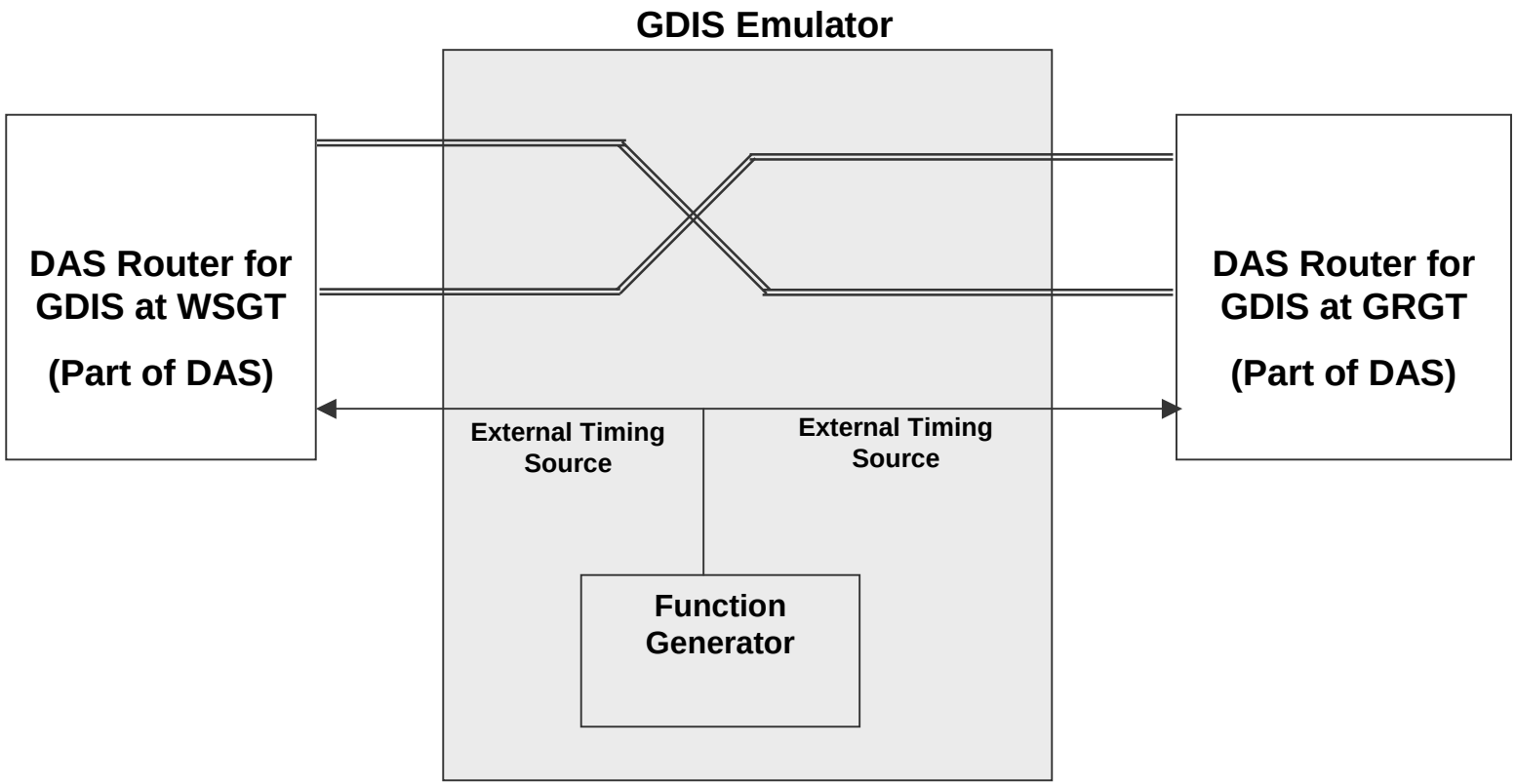
CTFS Emulator Description



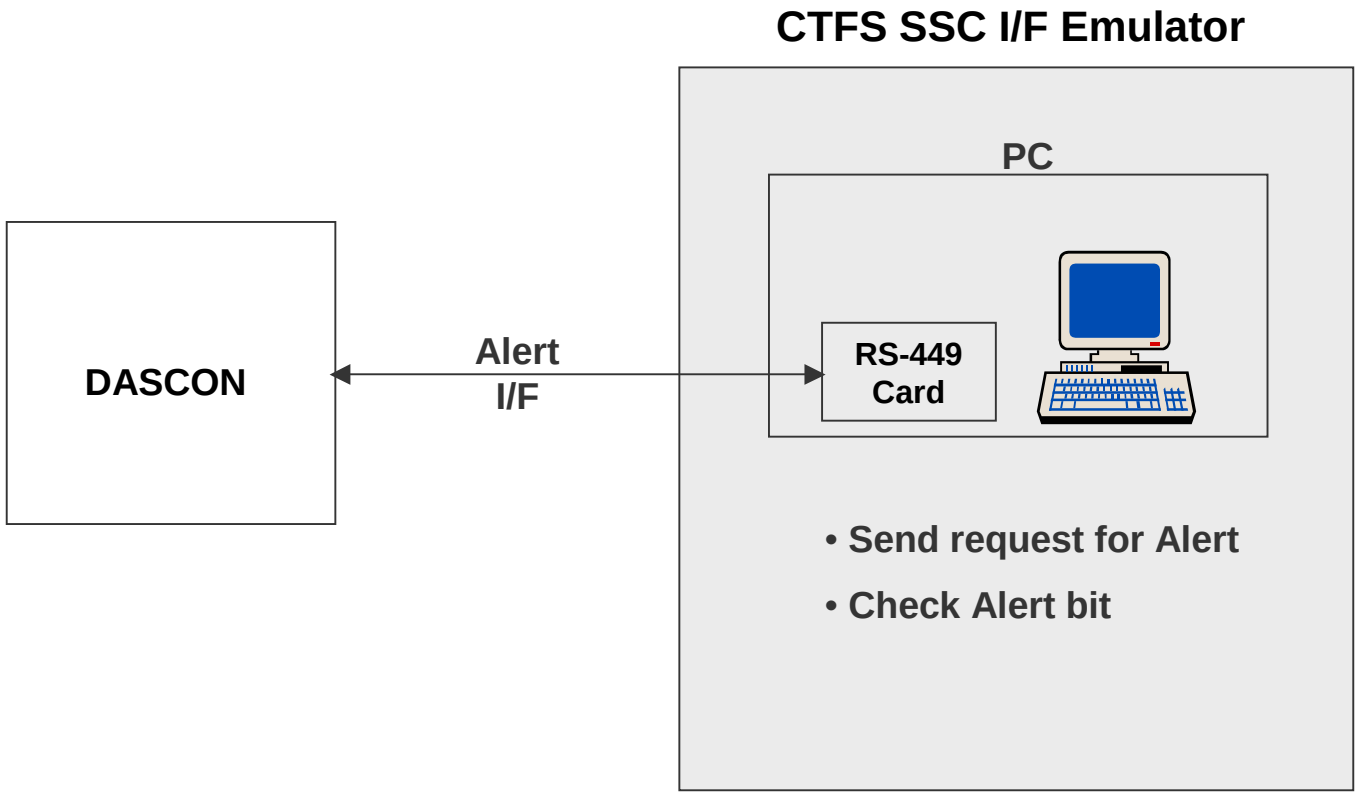
NISN Emulator Description



GDIS Emulator Description



CTFS SSC I/F Emulator Description



Test Case Considerations

- **DASCON Development Schedule Impact on Verification**
  - DASCON not scheduled for complete completion until 12/01
  - Anticipate having tested code to support System I&T and Verification earlier
  - Some Regression Testing may be required
- **Three complete IBUGs and two DMGs will be available by Sept 2001**
- **There will be a complete processing chain (for both WSGT and GRGT) at start of Verification (9/01)**
- **A group of SRD requirements may be verified by multiple test cases**
  - e.g., DMG uses IFG for acq tests and WSGT for Doppler testing

Verification Testing Configurations

Verification Testing include individual and combinations of the following:

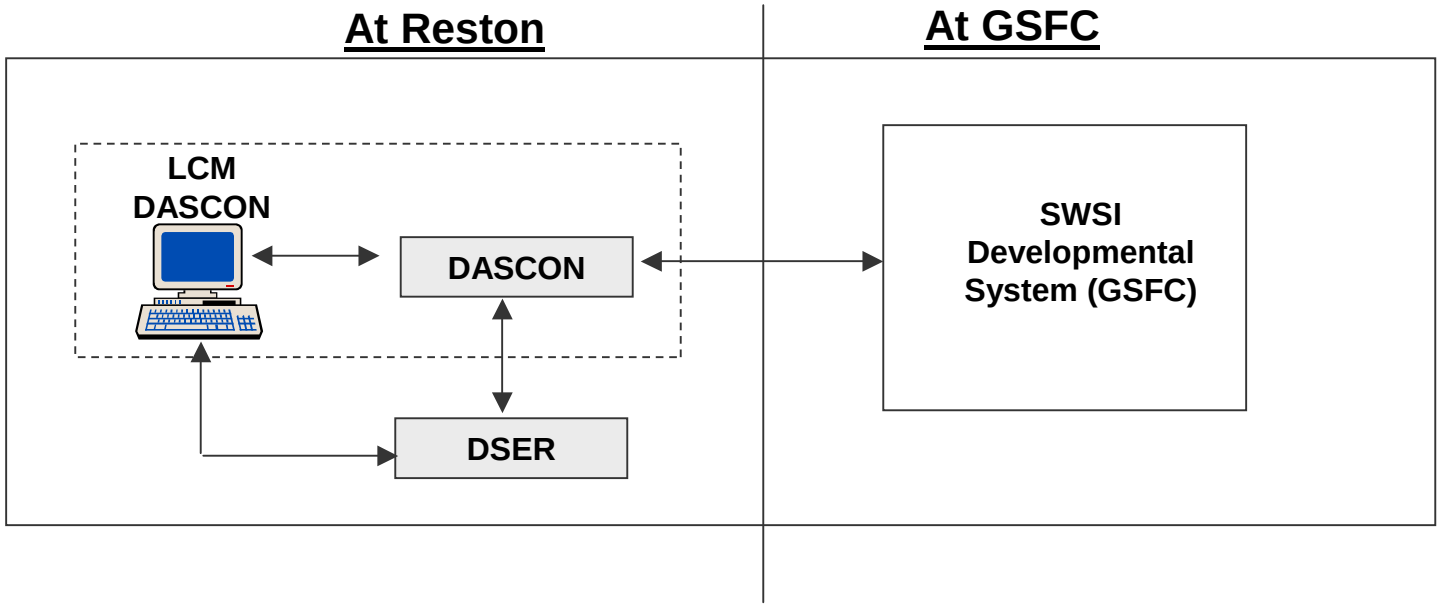
- **GSFC/Reston**
  - DASCON/Customer interactions using (Developmental Environment) SWSI (~ Fall 2001)
- **Reston**
  - DASCON /Customer interactions using LCM
  - Detailed DMG performance using IF Generator
  - EMC I/F CI, ICON and IBUGs using P/P EMC
  - Timing and Frequency using CTFS Emulator
  - Vector Management using P/P ECON
  - Customer Data I/F using NISN Emulator
  - DASCON/GRGT DAS Equipment interaction using GDIS Emulator
  - Status and performance Monitoring using all DAS Subsystems/CIs
  - DASCON/Alert I/F using an emulator for CTFS SSC interface
- **WSGT**
  - DMG performance using actual User Doppler via Simulation Services or 'shadow' an actual user mission
  - ECON-EXEC ADPE Interface Testing using actual Exec ADPE I/F

Test Cases
(160 Demo; 65 Test Requirements)

Test Case	SRD Reference Paragraph	Test Case Title	Location	Key Support equipment	Associated Analysis Cases	Associated Inspection Cases
1	3.1.1.1; 3.1.7.2; 3.2.1.1; 3.2.7.2; 3.2.1	DASCON/Customer interactions using SWSI	GSFC/ Reston	GSFC SWSI		
2	3.1.1.1; 3.1.2.1 - 3.1.2.3; 3.1.2.4; 3.1.6; 3.1.8.3 3.2.1.1; 3.2.2.1 - 3.2.2.3; 3.2.2.4; 3.2.6	Customer interactions and Resource Allocation using LCM	Reston	None		
3	3.1.4.2; 3.2.4.2	Detailed DMG performance using IF Generator	Reston	IFG		
4	3.1.3.1; 3.1.2.2.2.d; 3.1.4.1; 3.1.6.a; 3.1.7-1-3.1.7.3; 3.1.5; 3.1.6 ; 3.1.8; 3.1.9; 3.2.2.2.1; 3.2.2.4.1-3.2.2.4.2; 3.2.3.1; 3.2.4.1; 3.2.5.2.1; 3.2.7.1- 3.2.7.3; 3.2.5; 3.2.6; 4.2.1.b	Full-up Factory DAS	Reston	- P/P EMC - Factory ECON	A1,A2, A6, A7	
5	3.1.2.4 3.2.2.4	Vector Management using Factory ECON	Reston	Factory ECON		
6	3.1.5 3.2.5	Customer Data I/F using NISN Emulator	Reston	NISN Emulator		
7	3.1.2.1 - 3.1.2.3 3.2.2.1 - 3.2.2.3	DASCON/GRGT DAS Equipment interaction using GDIS Emulator	Reston	GDIS Emulator		
8	3.1.7.1; 3.2.7.1	DASCON/Alert I/F using CTFS SSC Emulator	Reston	CTFS SSC Emulator		
9	3.1.4.2; 3.2.4.2	DMG performance with Doppler	WSGT	- User Sim - User S/C		
10	ECON Upgrade	ECON - Exec ADPE I/F	WSGT	WSC Exec ADPE		
11	5.4.g	DMG EMI Testing	EMI Labs	None		I4
12	5.4.e, 5.4.f, 5.4.h	DAS-WSC EMI Susceptibility Testing	WSGT, GRGT	None		I4

Test Case 1

DASCON/Customer interactions using SWSI



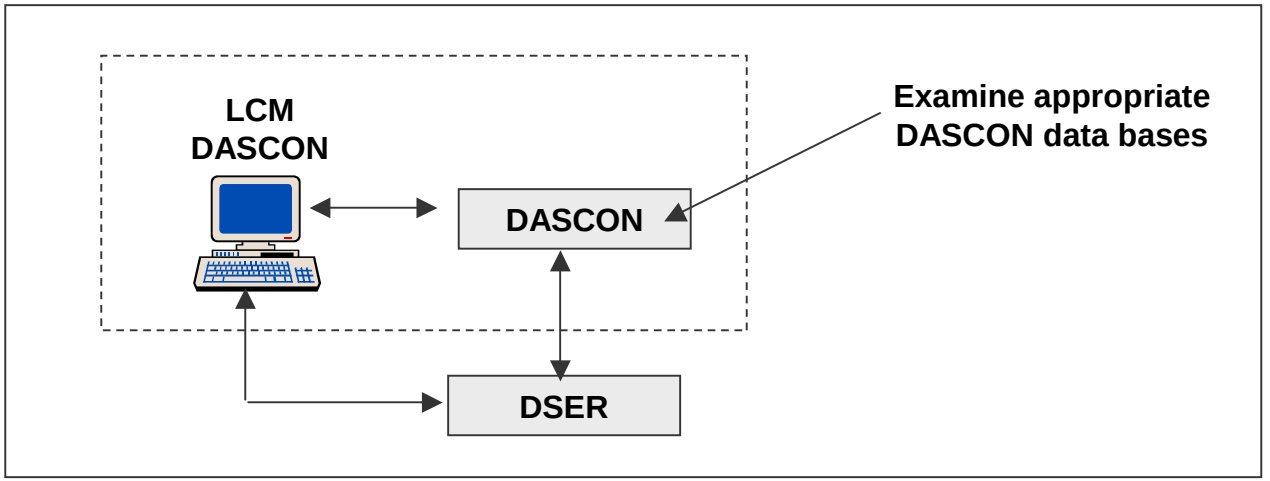
Test Objectives; Test/Demo:

- DAS supports Customer Interactions for Scheduling
- DAS provides service status and performance data to users

Test Case 2

Customer Interactions and Resource Allocation using LCM

At Reston



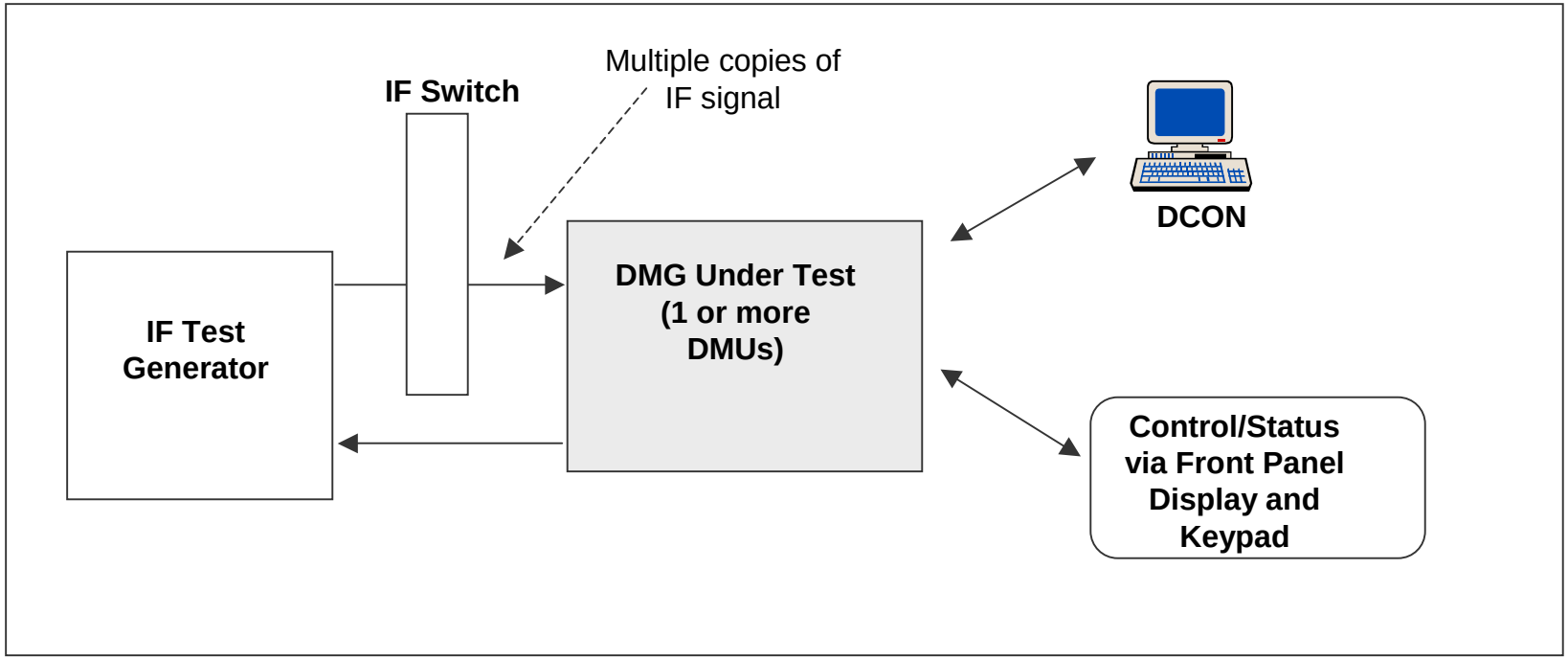
Test Objectives; Test/Demo:

- DAS supports Customer Interactions for Scheduling
- DAS provides user service status
- DAS performs DAS equipment resource allocation as per schedule and user requests

Test Case 3

Detailed DMG performance using IF Generator

At Reston



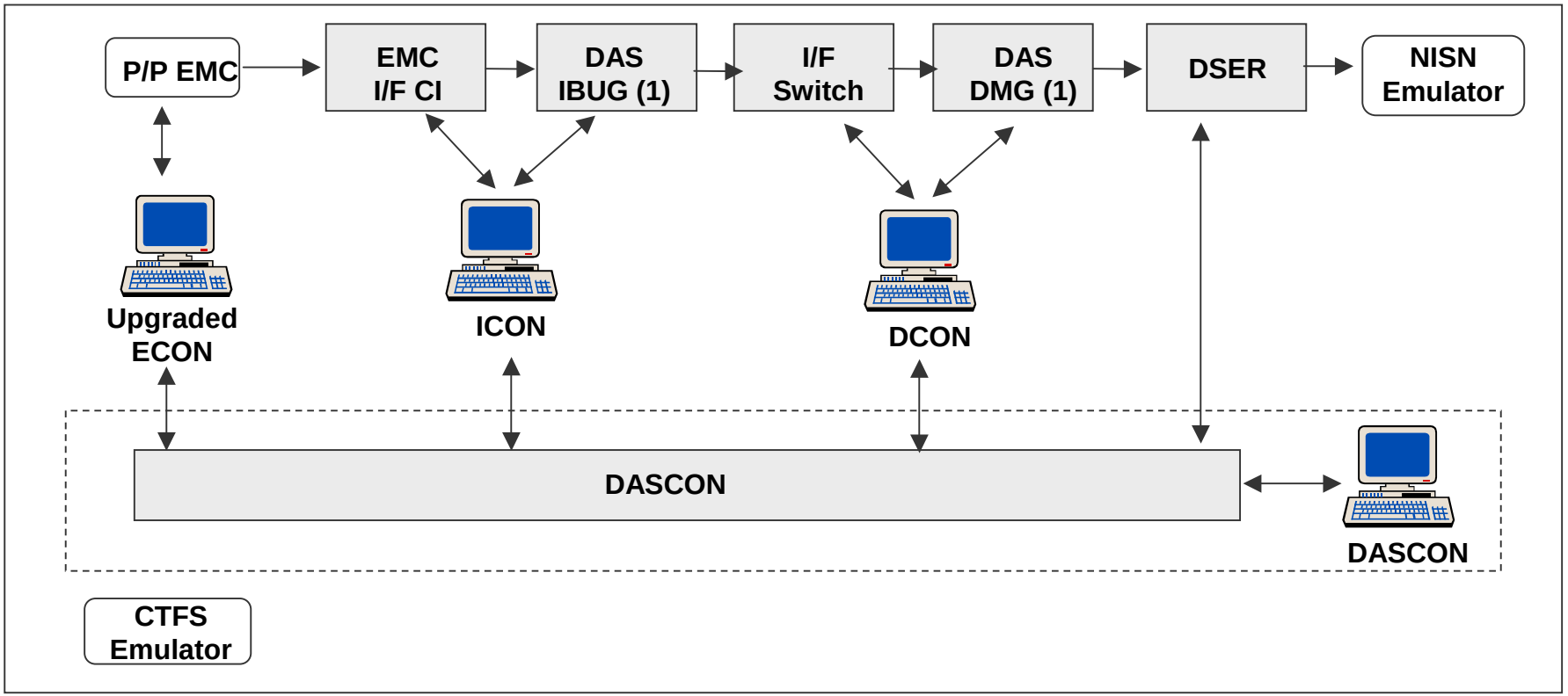
Test Objective; Test/Demo:

Detailed Demod functional and performance requirements

Test Case 4

Full-up Factory DAS

At Reston



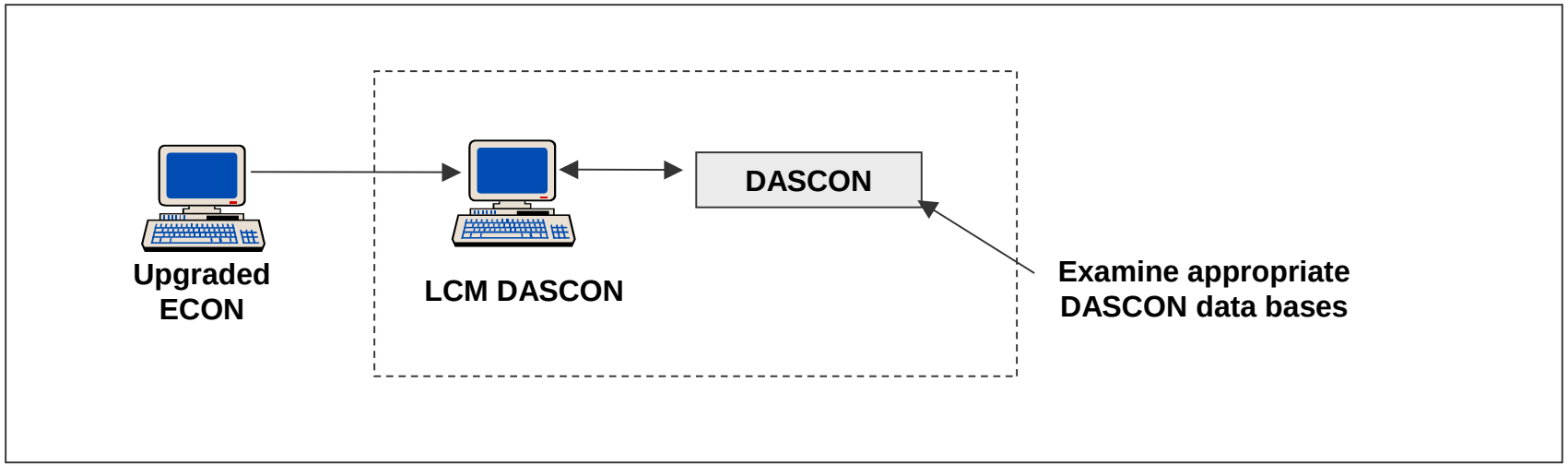
Test Objective; Test/Demo:

Status monitoring and resource allocation requirements

Test Case 5

Vector Management using Factory ECON

At Reston



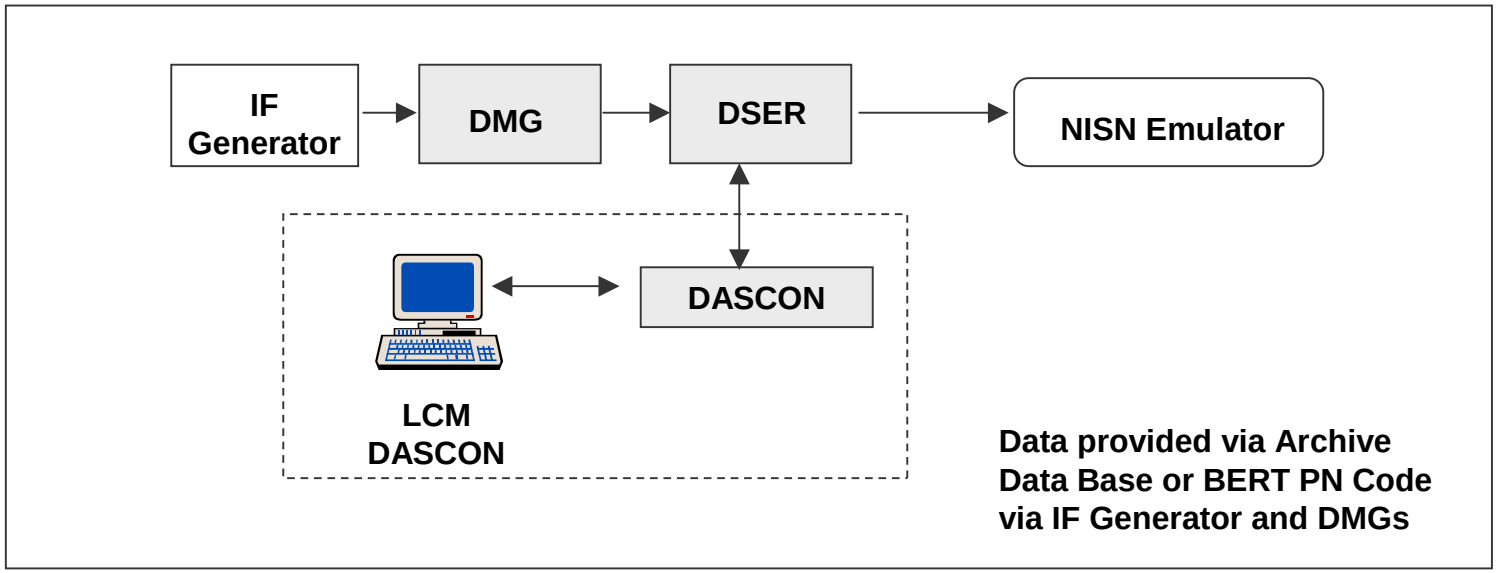
Test Objective; Test/Demo:

DAS Vector Management

Test Case 6

Customer Data I/F using NISN Emulator

At Reston



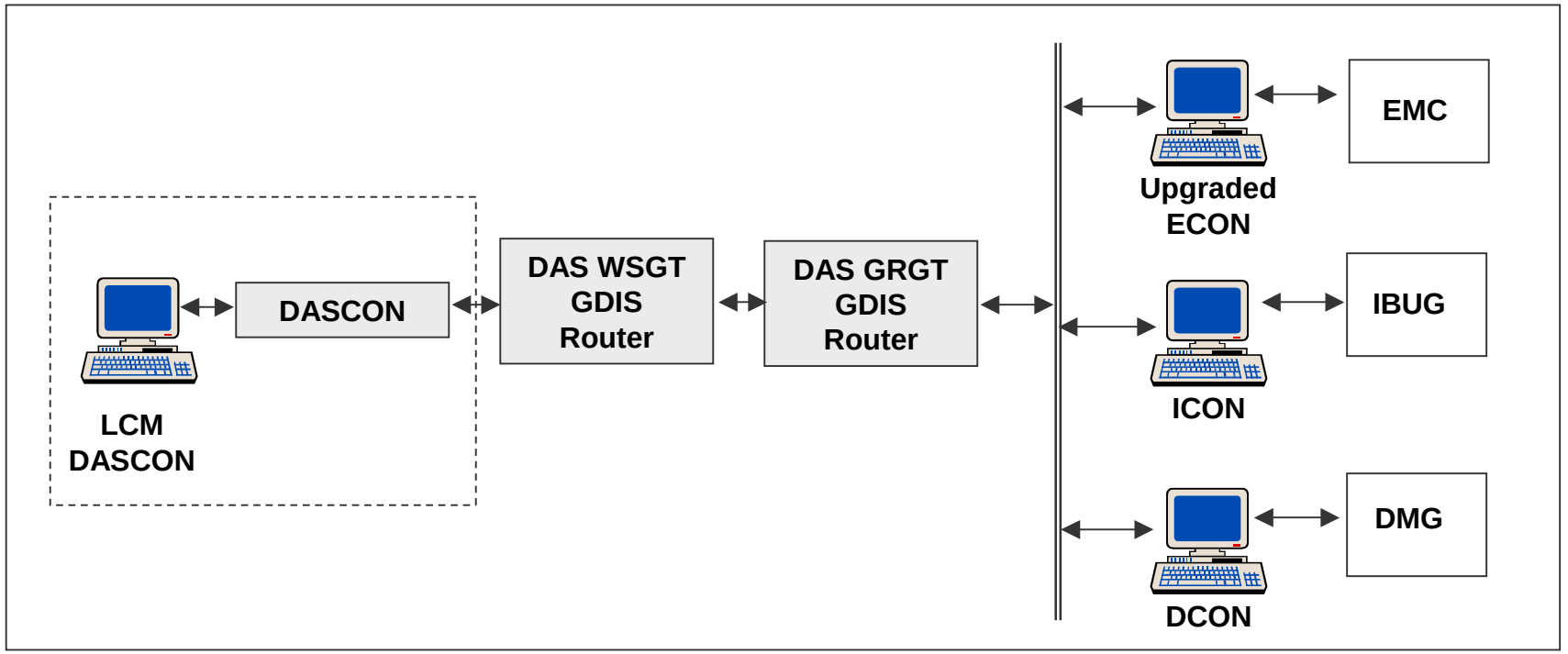
Test Objective; Test/Demo:

Provision of Customer Data via NISN

Test Case 7

GRGT DAS Equipment interaction using GDIS Emulator

At Reston



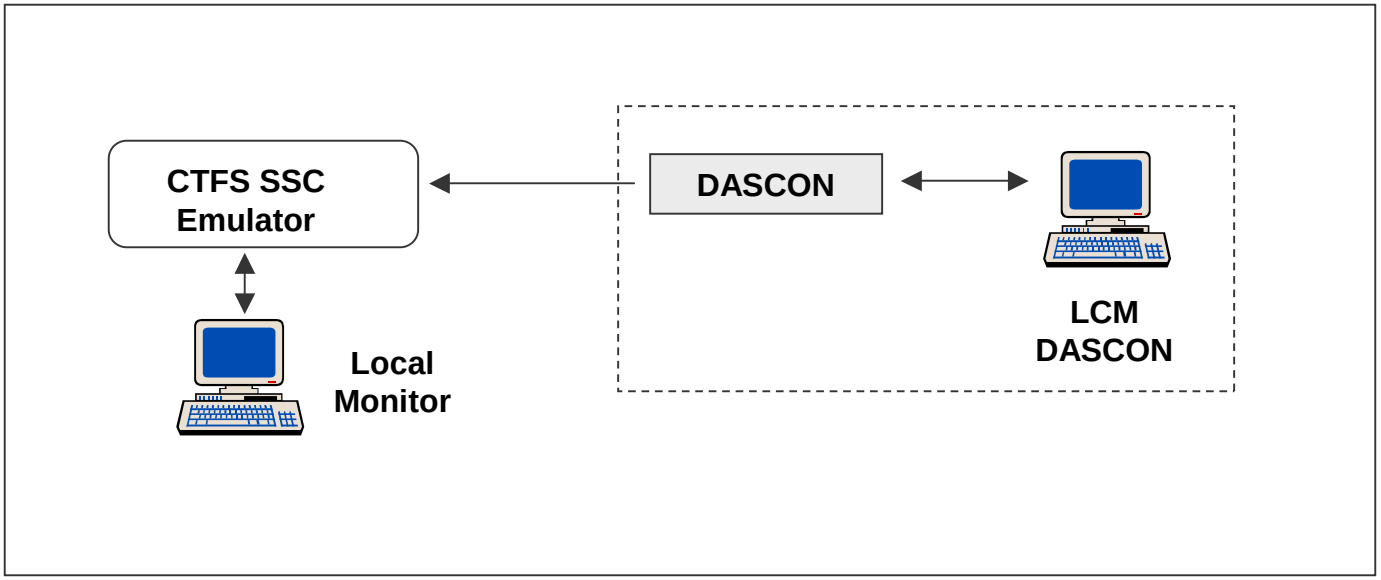
Test Objective; Test/Demo:

DASCON Control of GRGT equipment via GDIS

Test Case 8

DASCON/Alert I/F using CTFS SSC Emulator

At Reston



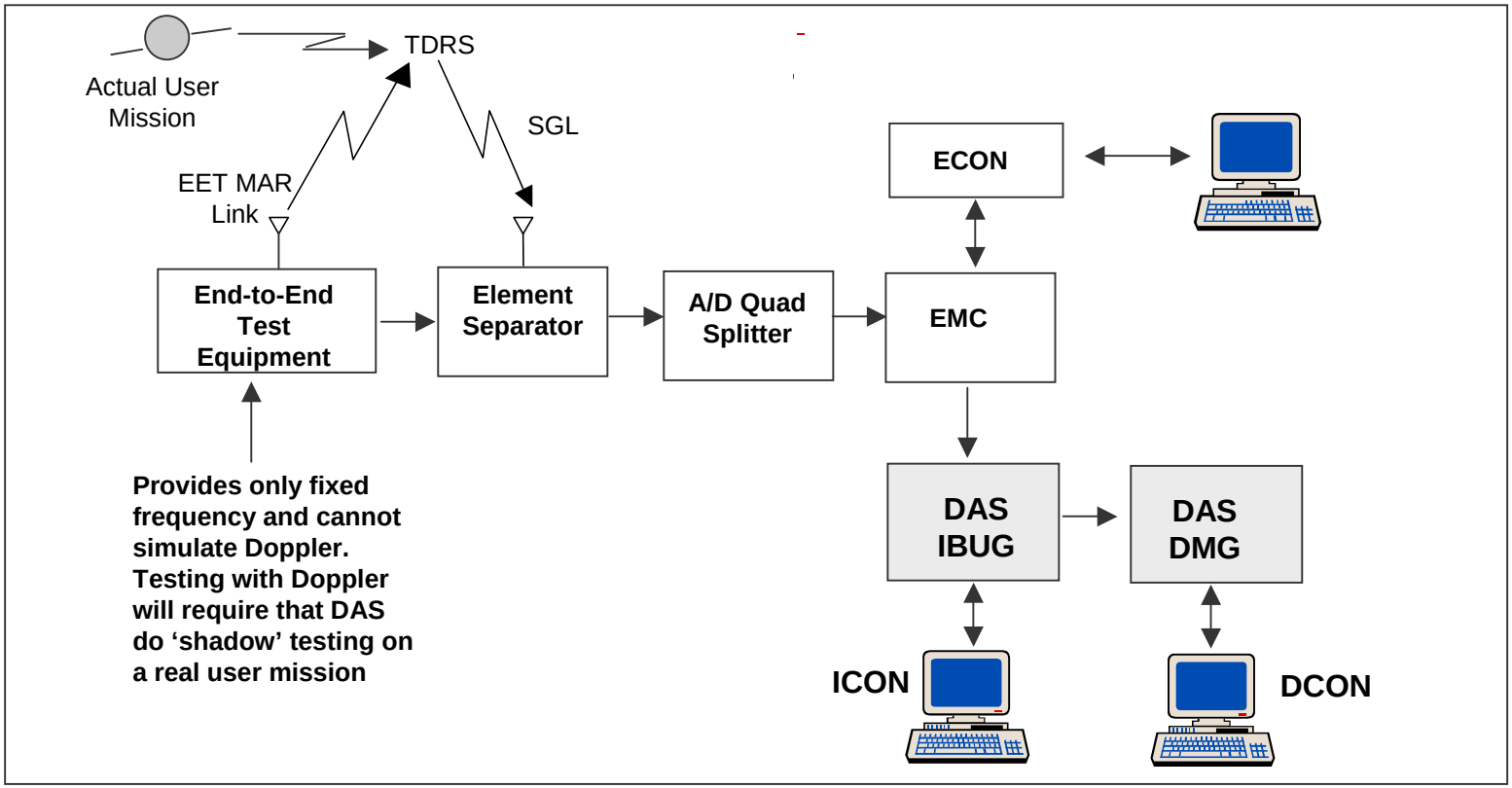
Test Objective; Test/Demo:

DASCON alert to CTFS SSC

Test Case 9

DMG Performance with Doppler

At WSGT



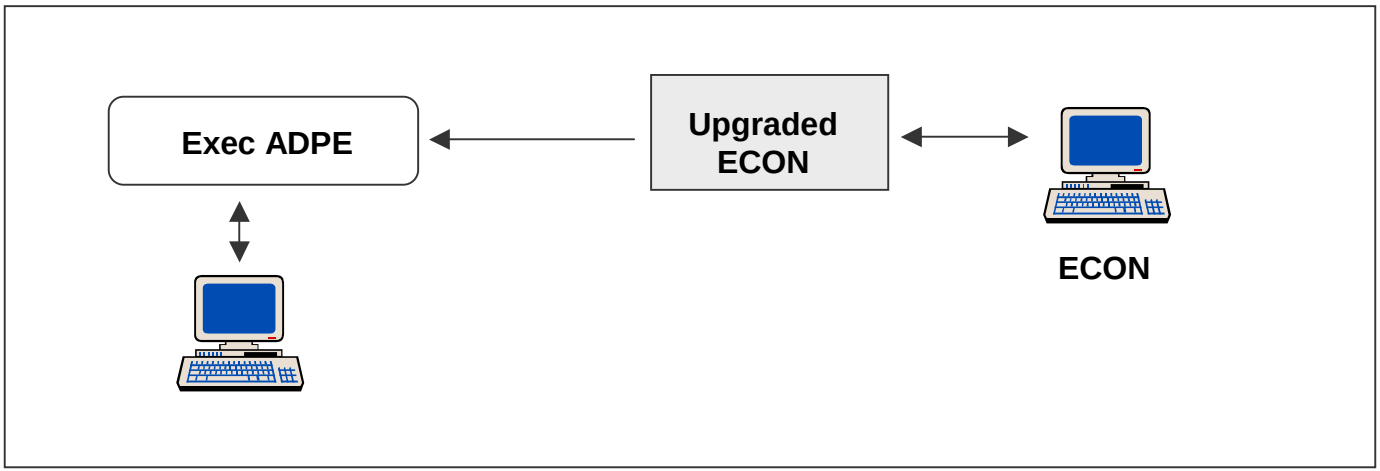
Test Objective; Test/Demo:

DMU performance with Doppler on signal

Test Case 10

ECON - Exec ADPE I/F

At WSGT



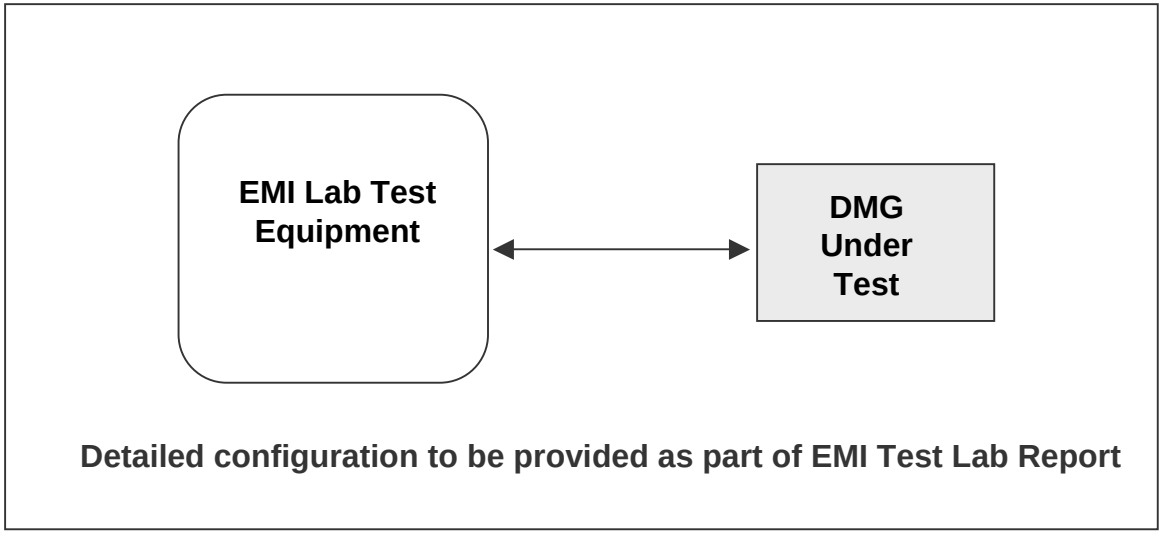
Test Objective; Test/Demo:

ECON I/F with Exec ADPE

Test Case 11

EMI Testing at EMI Test Labs

At EMI Test Labs



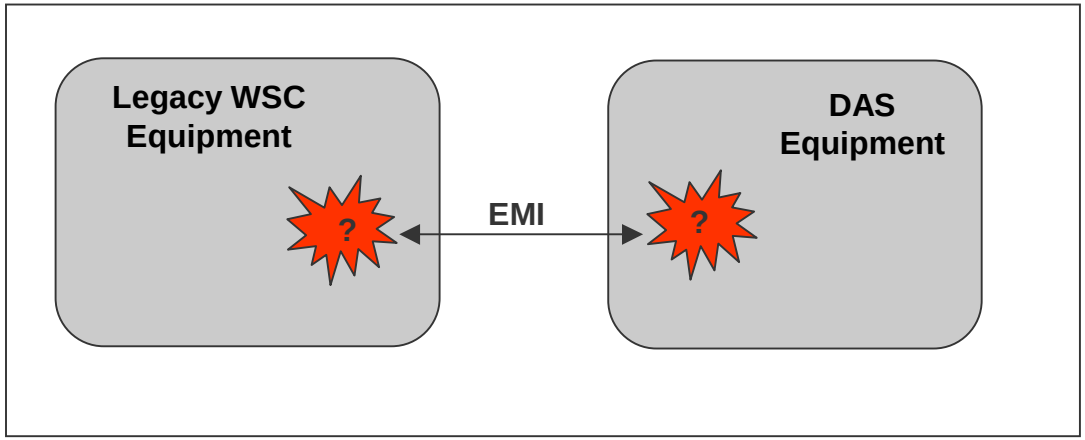
Test Objective; Test/Demo:

DMG compliance to FCC Class A

Test Case 12

EMI Susceptibility at GRGT and WSGT

At GRGT and WSGT



Test Objective; Demonstrate:

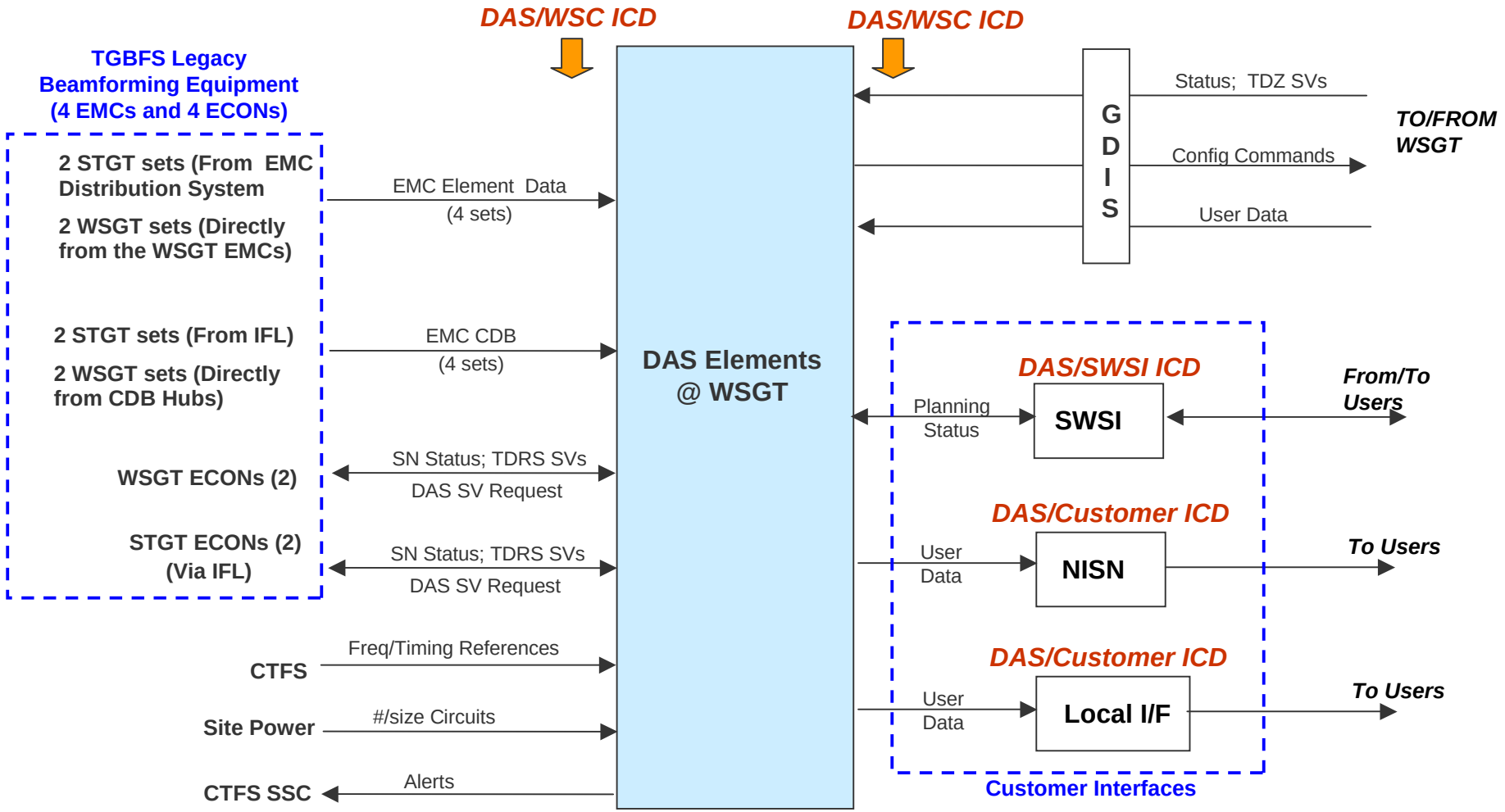
No EMI interference between equipments at GRGT/WSGT

Day-1 Agenda

1. CDR/DDR Introduction
2. DAS Overview
3. DAS Ops Concept Overview
4. SWSI Overview
5. DAS Systems Engineering Summary
6. DAS Verification Planning
7. **DAS Design Overview**
   - **External Interface**
   - **System Block Diagrams**
   - **Internal Interface**
   - **Implementation Approach**
   - **Rack Overview**
8. DAS Detailed Hardware Design

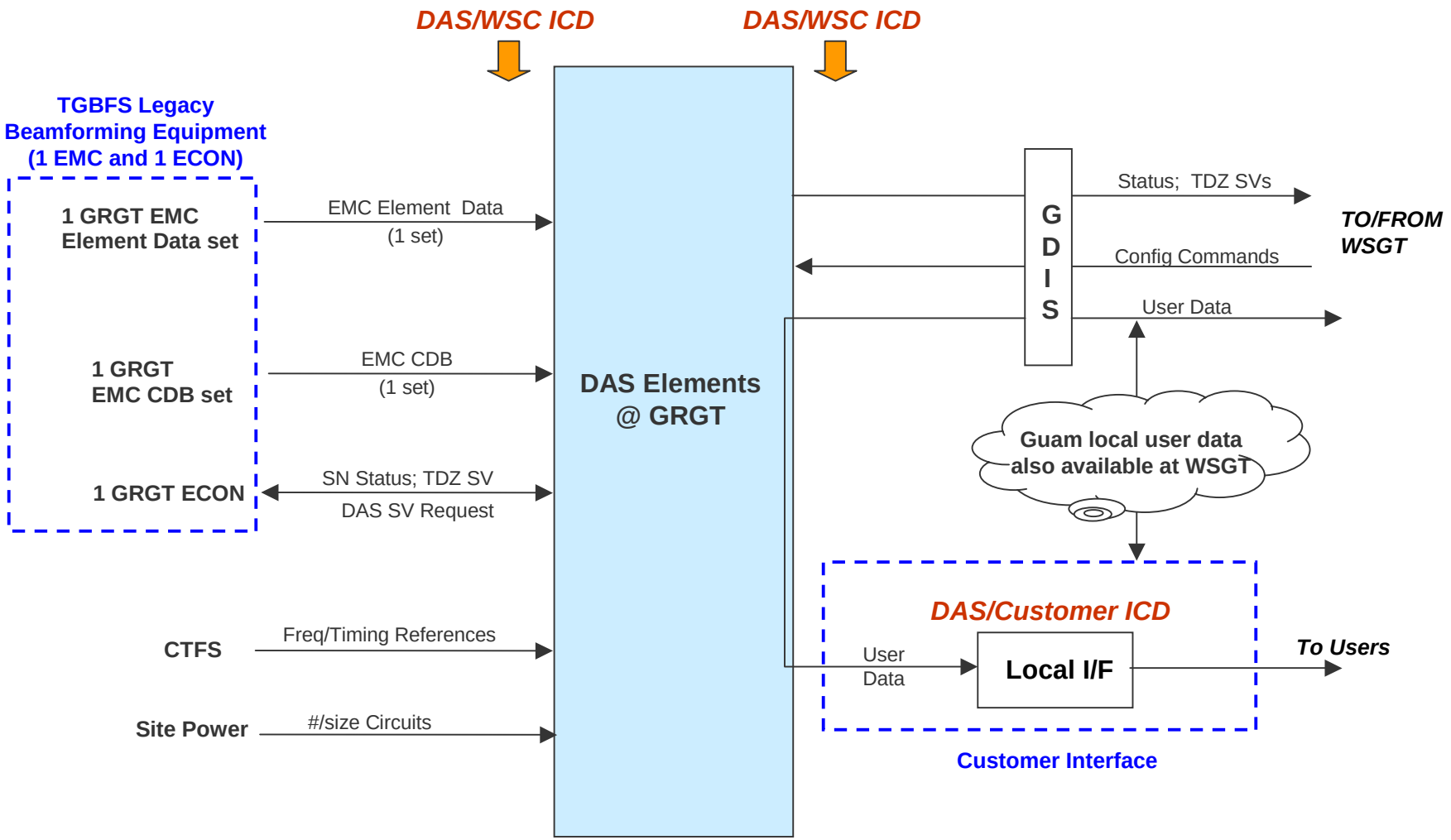
External DAS Interfaces @ WSGT

(Documented in 3 External ICDs)



External DAS Interfaces @ GRGT

(Documented in 2 External ICDs)



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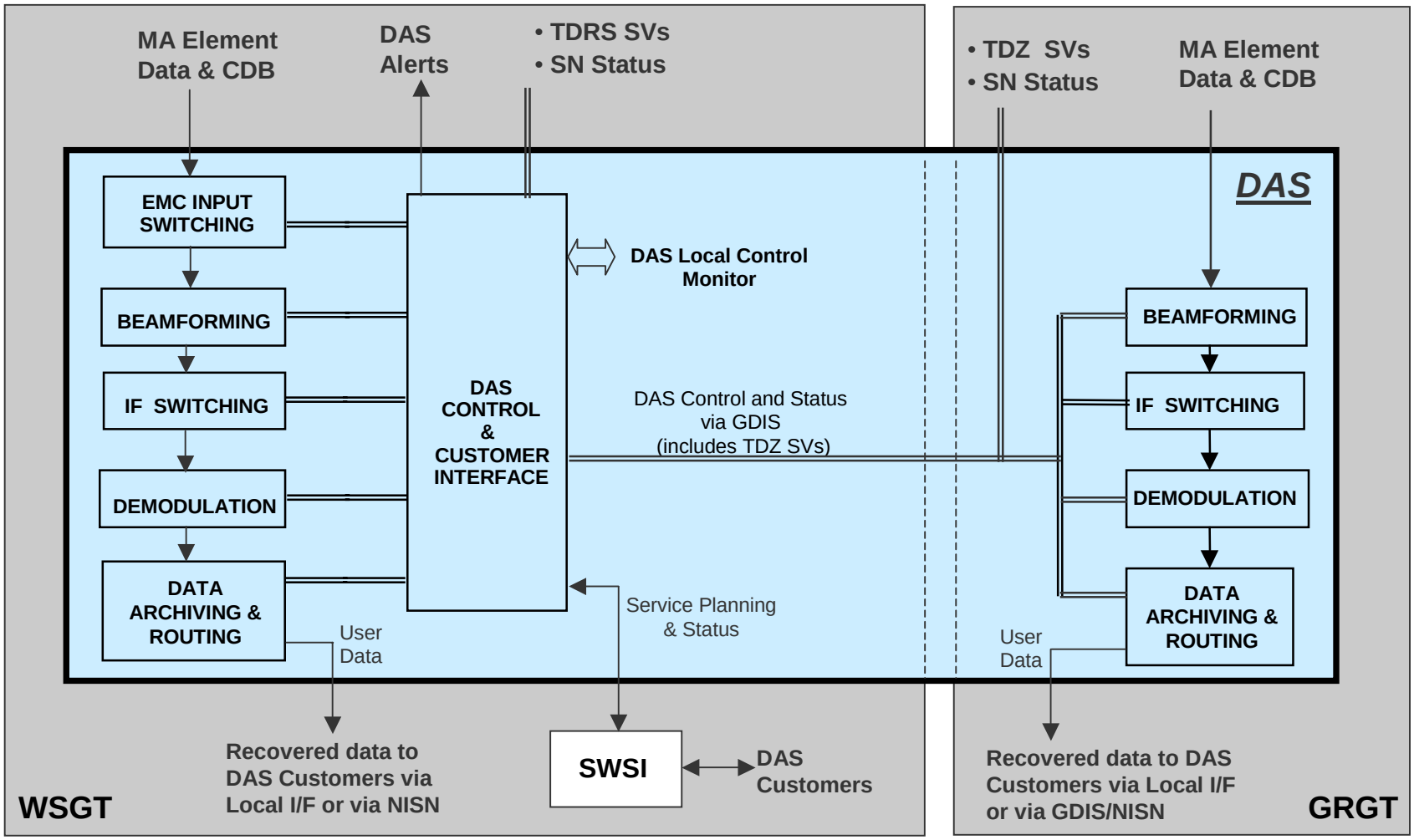
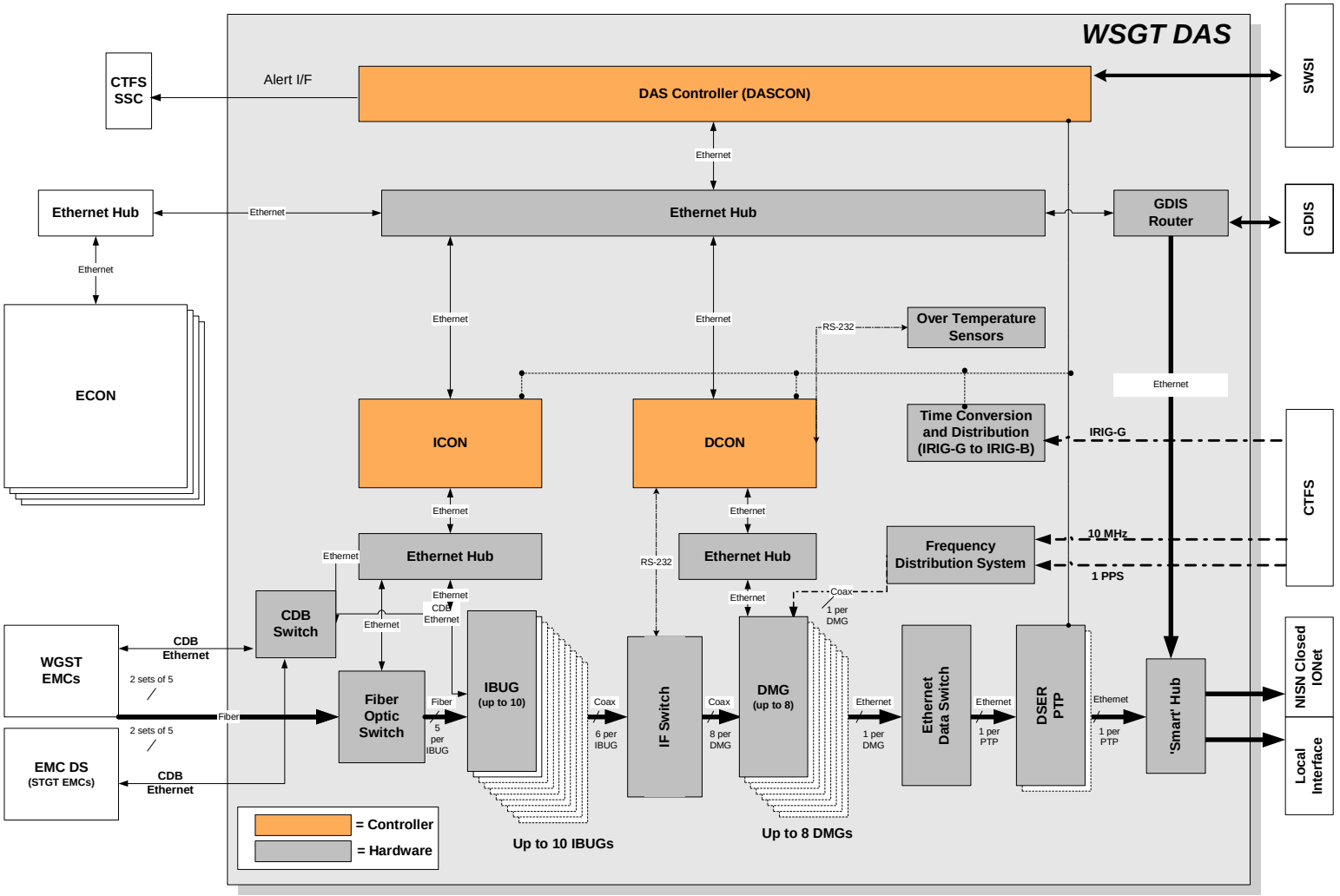
DAS Functional Architecture



WSGT DAS System Block Diagram



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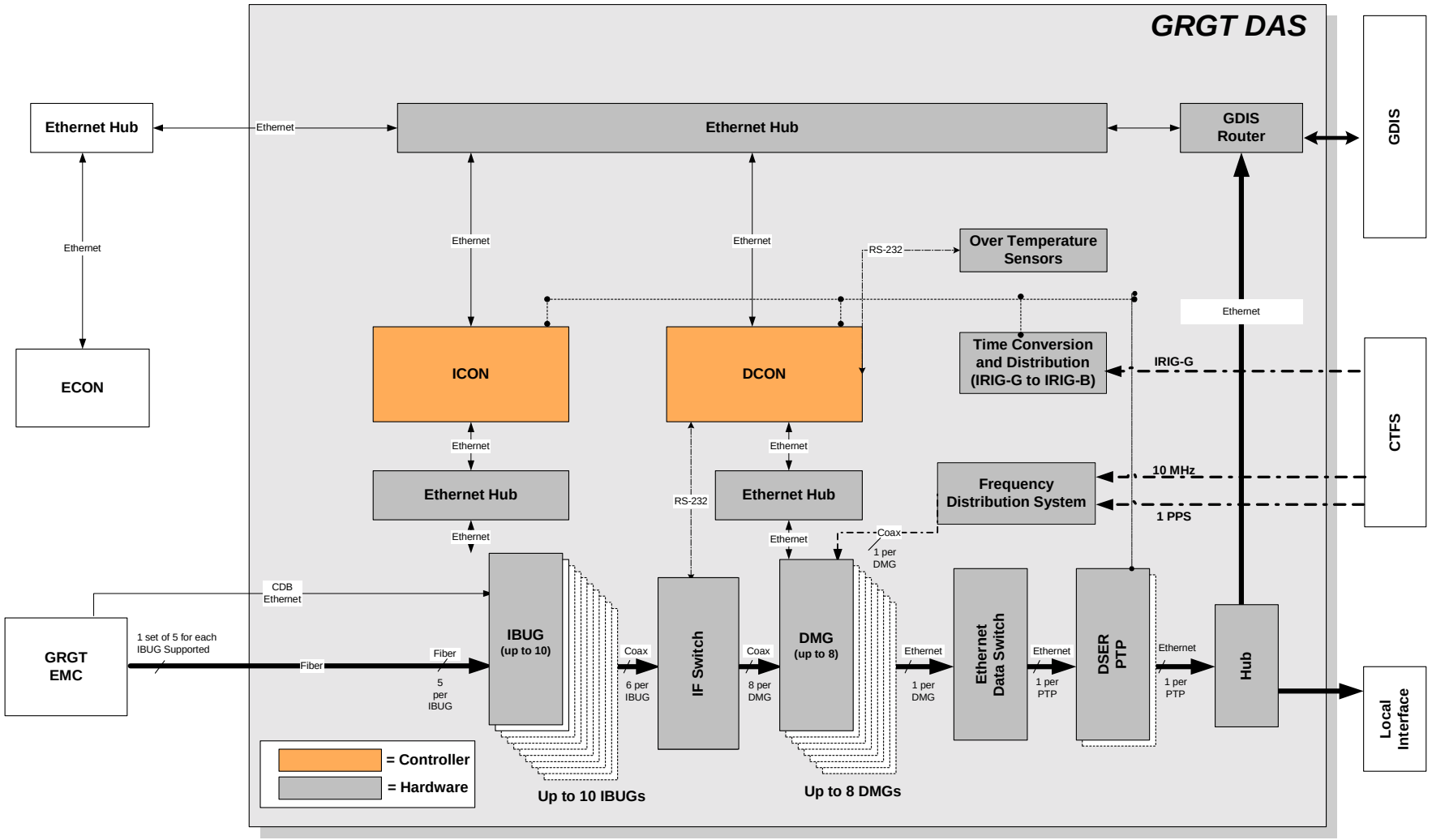
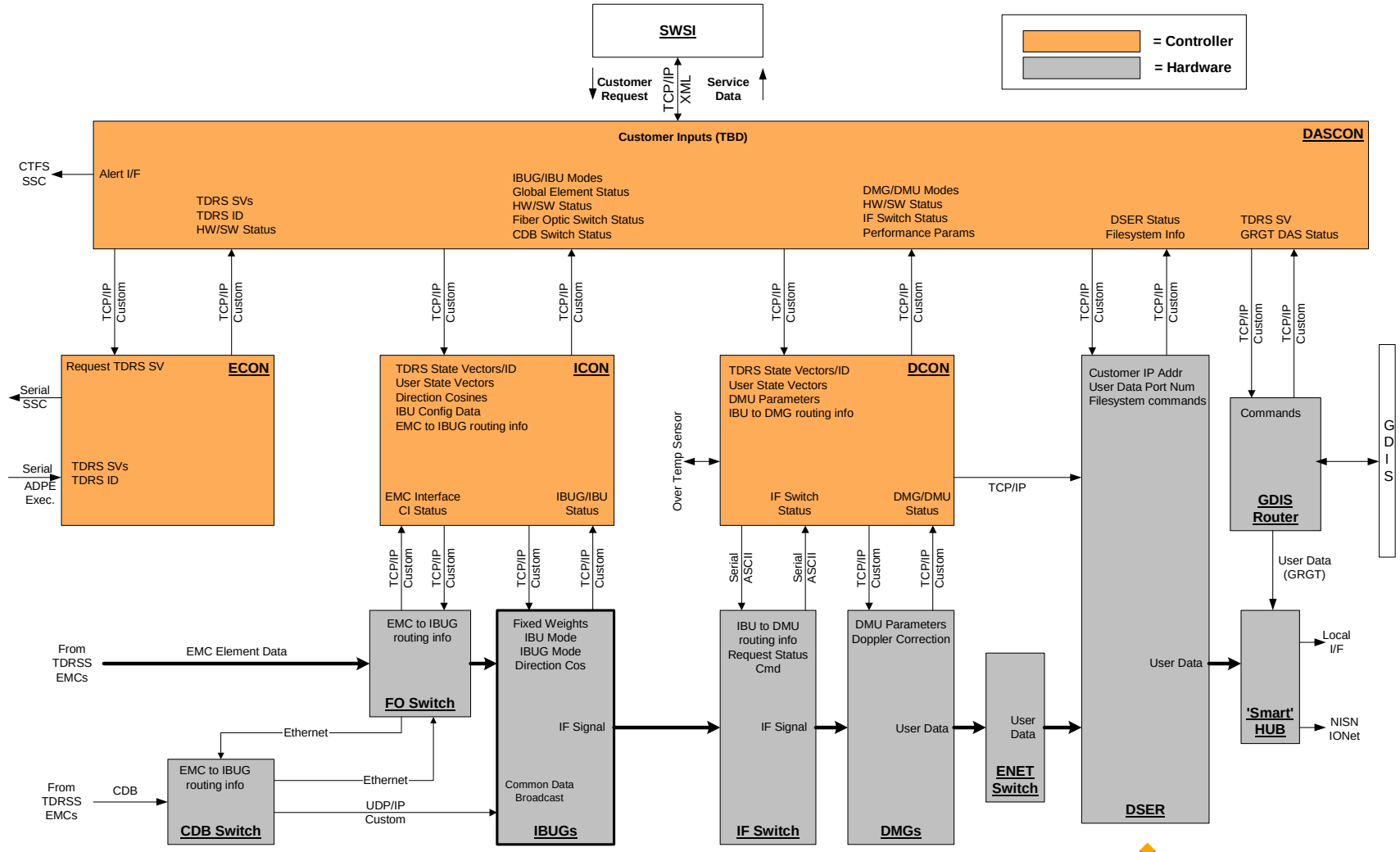
GRGT DAS System Block Diagram



Internal Interfaces Overview

Documented in DAS Internal ICD (Doc 014-600006)



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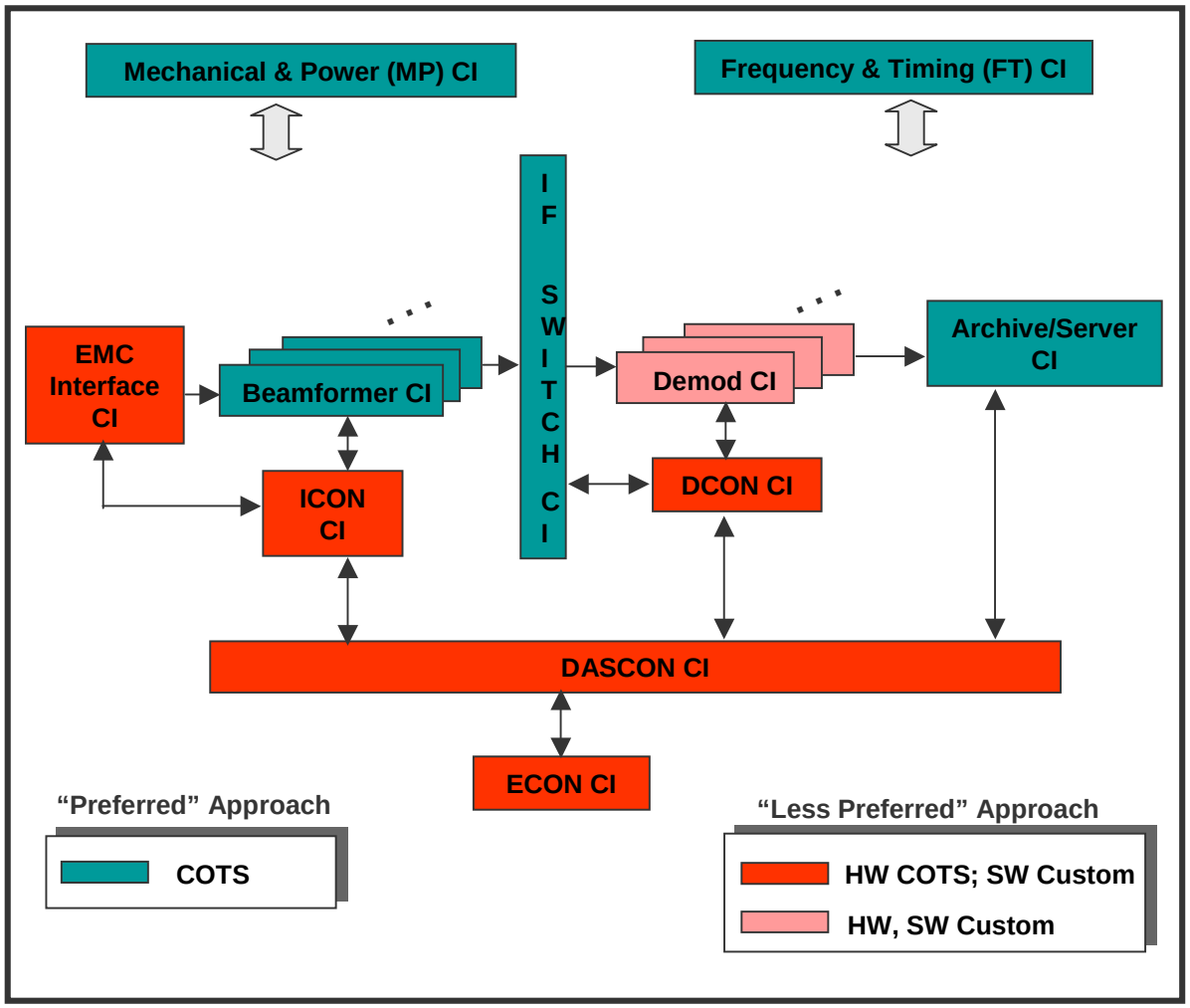
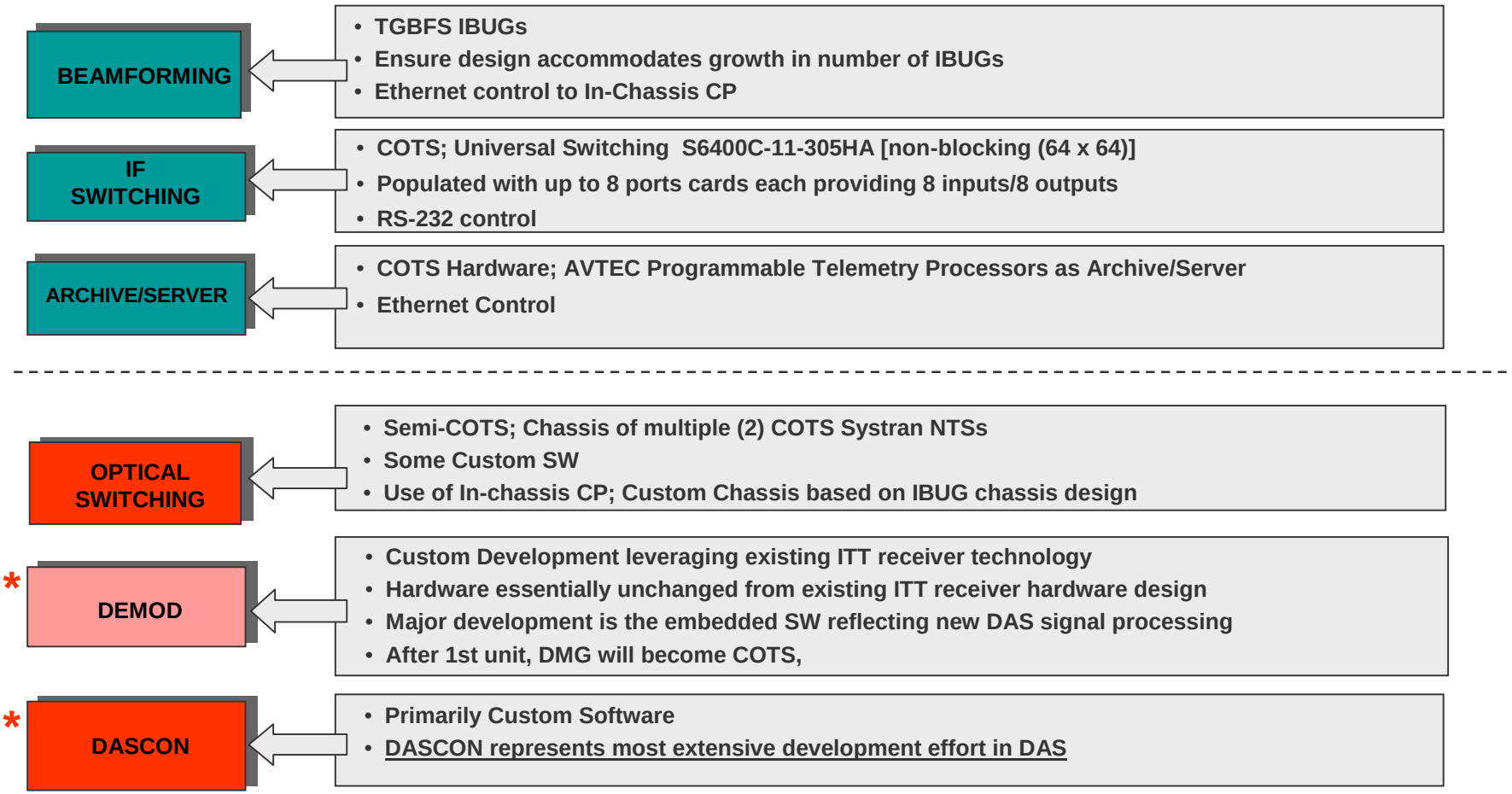
CI Development Approach Overview



- COTS used whenever feasible
  - 5 COTS CIs
  - EMC I/F CI Semi-COTS
- 4 CIs are Controllers comprised of COTS HW and Custom SW
  - ECON and ICON are modifications of existing TGBFS design
  - DCON design based on ICON/ ECON design
- Demod
  - HW based on existing ITT Rcvr
  - Firmware tailored to DAS Requirements
  - COTS after 1st unit
- Most extensive development efforts are:
  - DASCON SW
  - Demod Firmware

CI Implementation Approach Overview

Major Signal Processing Elements



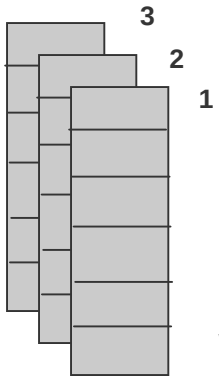
* Custom Development primarily for: Demod Embedded SW and DASCON SW

CI Implementation Approach Overview

Supporting Elements (All COTS)

FREQUENCY DISTRIBUTION	• COTS; Datum 9611 [12 outputs per chassis] • Distributes CTFS 10 MHz to each demod Chassis • One each at WSGT and GRGT
TIMING DISTRIBUTION	• COTS; Brandywine GPS80J • Converts IRIG-G; Distributes IRIG-B to controllers and 1 PPS to demods • One each at WSGT and GRGT
ETHERNET SWITCHES/ HUBS	• COTS: 3Com Superstack II Ethernet Hub; Cisco 1924-EN Ethernet Switch; Cisco 2912 'Smart' Hub, Cisco 2611 Router
EMI RACKS	• COTS: Pentair EMI 270.5 compliant racks with modifications • NASA approved racks • 3 racks at WSGT and 3 STDN 270-5 EMI racks at GRGT (initially)
OVER-TEMPERATURE MONITORING	• COTS; Lakeshore Model 218 • Single chassis with 8 sensors to provide temp monitoring in every rack • One each at WSGT and GRGT

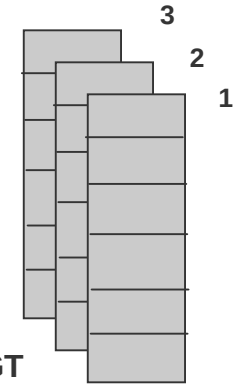
STDN 270.5 Rack Count



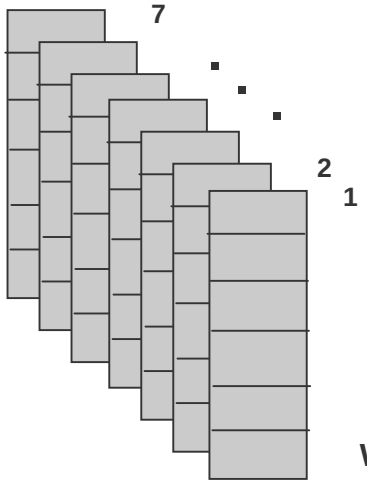
WSGT

Initial DAS Installation

- Basic Infrastructure for expandability
- 1 IBUG for each TDRS node
  - 1 IBUG @ GRGT
  - 2 IBUGs @ WSGT
- 1 DMG @ GRGT; 1 DMG @ WSGT
- 1 PTP



GRGT

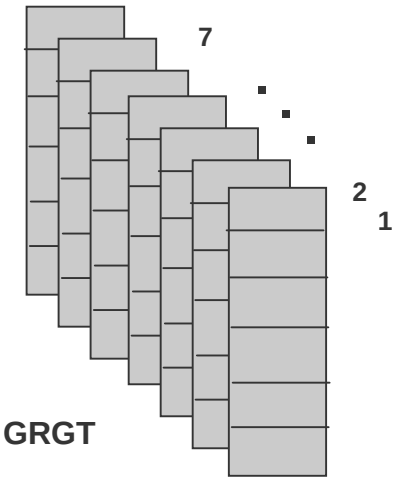


WSGT

Fully Implemented DAS

- Basic Infrastructure maintained
- 10 IBUGs @ GRGT; 10 IBUGs @ WSGT
- 8 DMGs @ GRGT; 8 DMGs @ WSGT
- 2 PTP's

Rack details provided in CDR Section 8 (Hardware Design)



GRGT

Next

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Day-1 Agenda

1. CDR/DDR Introduction
2. DAS Overview
3. DAS Ops Concept Overview
4. SWSI Overview
5. DAS Systems Engineering Summary
6. DAS Verification Planning
7. DAS Design Overview
8. **DAS Detailed Hardware Design**
   - **EMC Interface**
   - **Beamformer**
   - **IF Switch**
   - **Demodulator**
   - **Frequency & Time**
   - **Mechanical and Power**

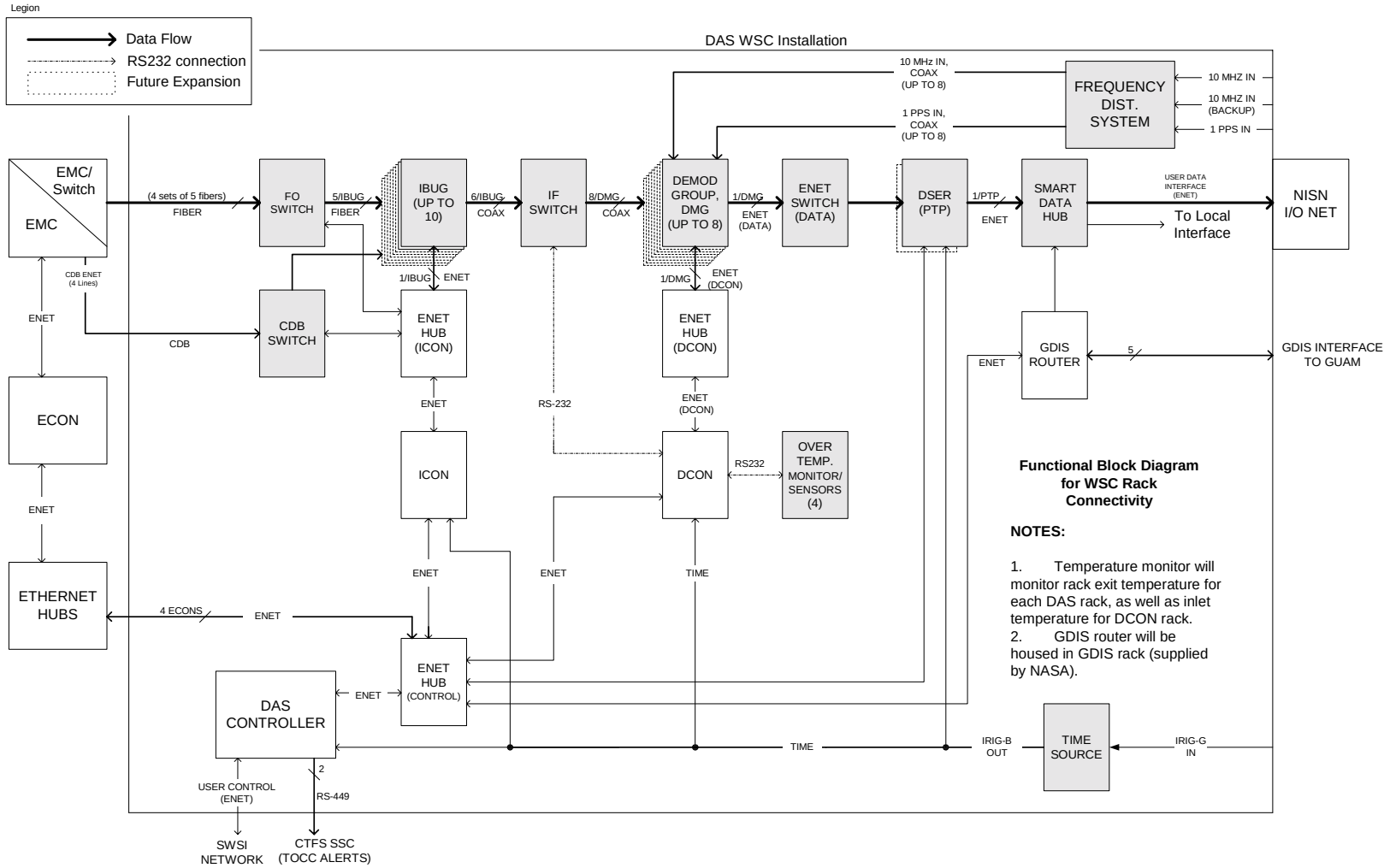
Hardware System Overview

- **DAS Hardware (HW) Configuration Items (CIs)**
  - EMC Interface CI
    - Fiber Optic (FO) Switch
    - Common Data Broadcast (CDB) Switch
  - Beamformer CI
  - IF Switch CI
  - Demodulator Group (DMG) CI
  - Frequency and Timing CI
    - Datum 9611 Distribution Amplifier
    - Modified GPS80J Converter and 1 pps Distribution Amplifier
  - Mechanical and Power CI
    - Temperature Monitor and Sensors
    - STDN 270.5 Racks
    - Cables
    - Ethernet Equipment

Key Hardware System Requirements

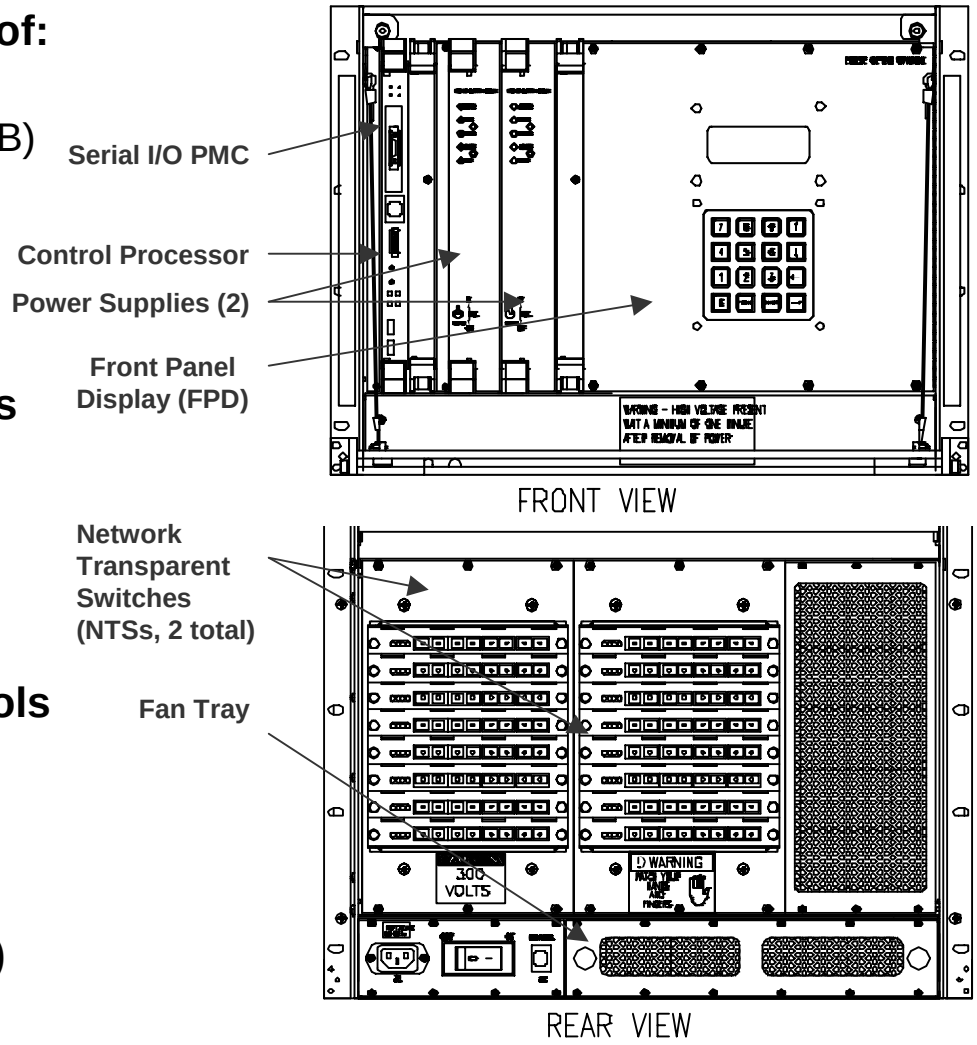
- **DAS hardware design allows expansion to support more than the required 50 simultaneous user streams**
  - Deployment will be expandable to support up to 50 user signal streams at WSC (STGT & WSGT) and 50 user signal streams at GRGT with no major modifications to delivered DAS racks
- **Provide necessary switching logic to efficiently support customer services**
  - Design uses automated input and output switches to optimally utilize DAS pooled resources
- **DAS must provide high inherent availability**
  - DAS components have a high degree of reliability (large MTBFs)
  - Redundant or hot-swappable LRUs are used where possible
  - Local monitoring/diagnostic capability on all ITT-built equipment
- **EMC Compliance**
  - All devices FCC Class A compliant (per HE-04-04)

Data Flow and Hardware CI's



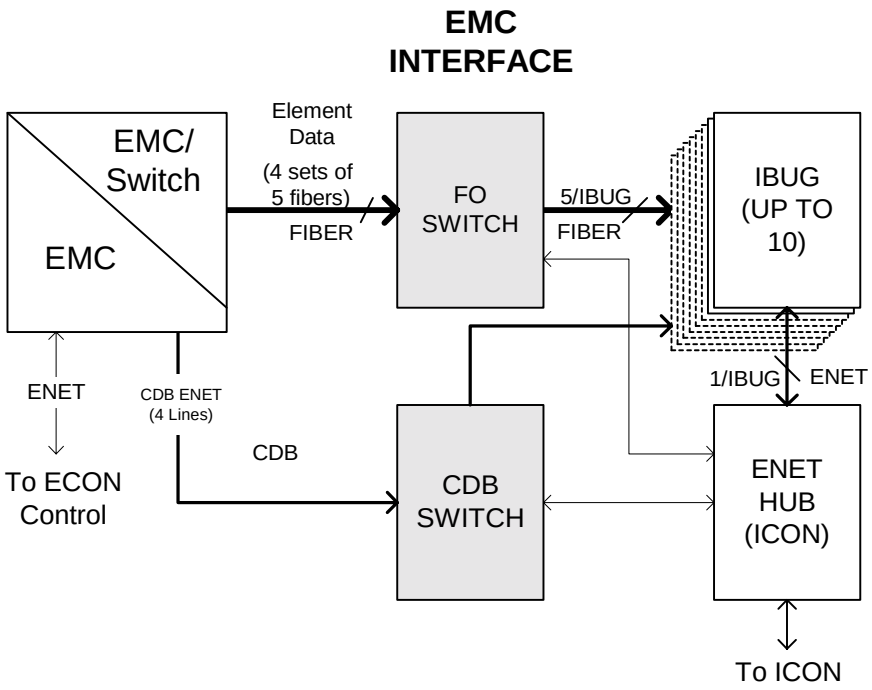
EMC Interface CI

- **EMC Interface CI is comprised of:**
  - Fiber Optic (FO) Switch
  - Common Data Broadcast (CDB) Switch
- **Controlled by ICON**
- **EMC Interface CI accepts inputs from up to 4 EMCs and routes them to up to 10 IBUGs**
- **Fiber Optic Switch Control Processor switches fiber optic connections directly and controls the CDB Switch via TCP/IP Ethernet Calls**
- **EMC Interface is at WSGT site only (GRGT uses a single EMC)**



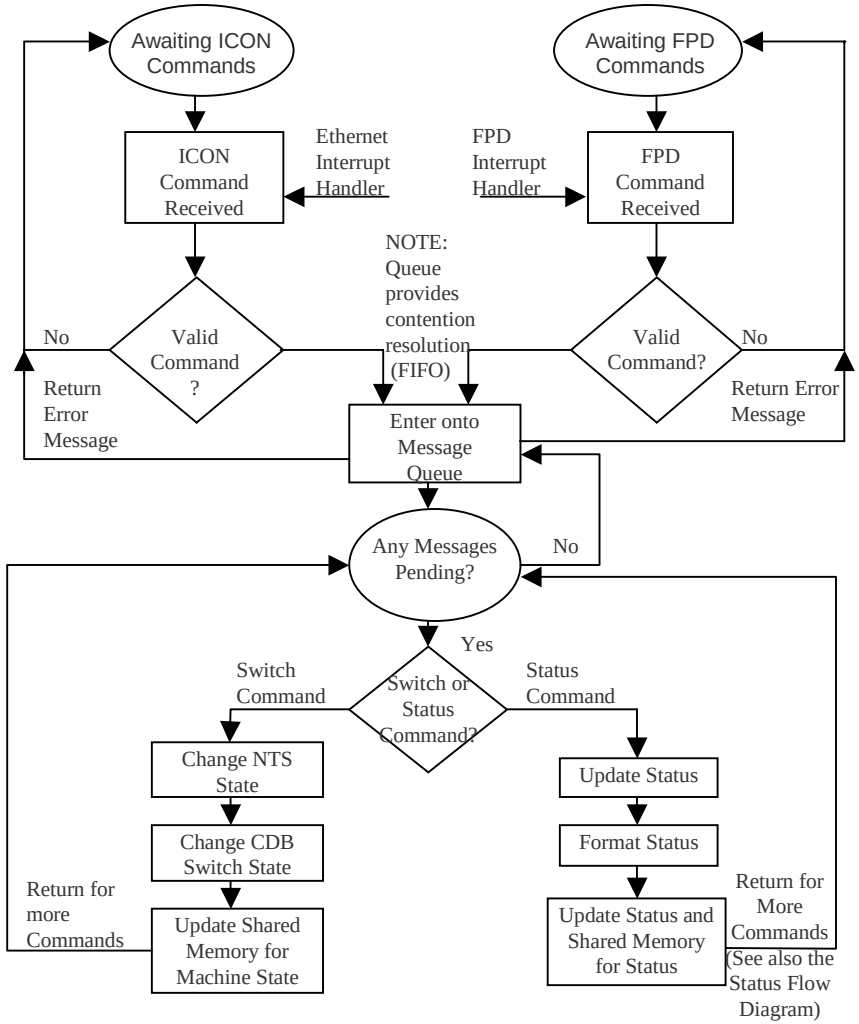
EMC Interface CI Requirements and Interfaces

- Route Fibre Channel outputs from EMCs to Beamformers
- Route Common Data Broadcast (CDB) data from EMCs to Beamformers
- Switch under control from either the ICON (normal operation) or the Front Panel Display (FPD) (for service)
- Report detailed status to DASCON and detect operational errors promptly
- Provide highly reliable operation



EMC Interface CI
Theory of Operation - Commands

- **Commands are issued from either the ICON or the Front Panel Display (FPD)**
- **Only two commands are valid:**
  - Change Switch Command
  - Request Detailed Status Command
- **All Invalid Commands (unrecognizable or improper) are detected and error messages are generated**
- **NTS Switch State and CDB Switch State are changed in rapid succession**
- **Non-volatile memory is used to store current state of Switch Settings for faster return upon loss of power**



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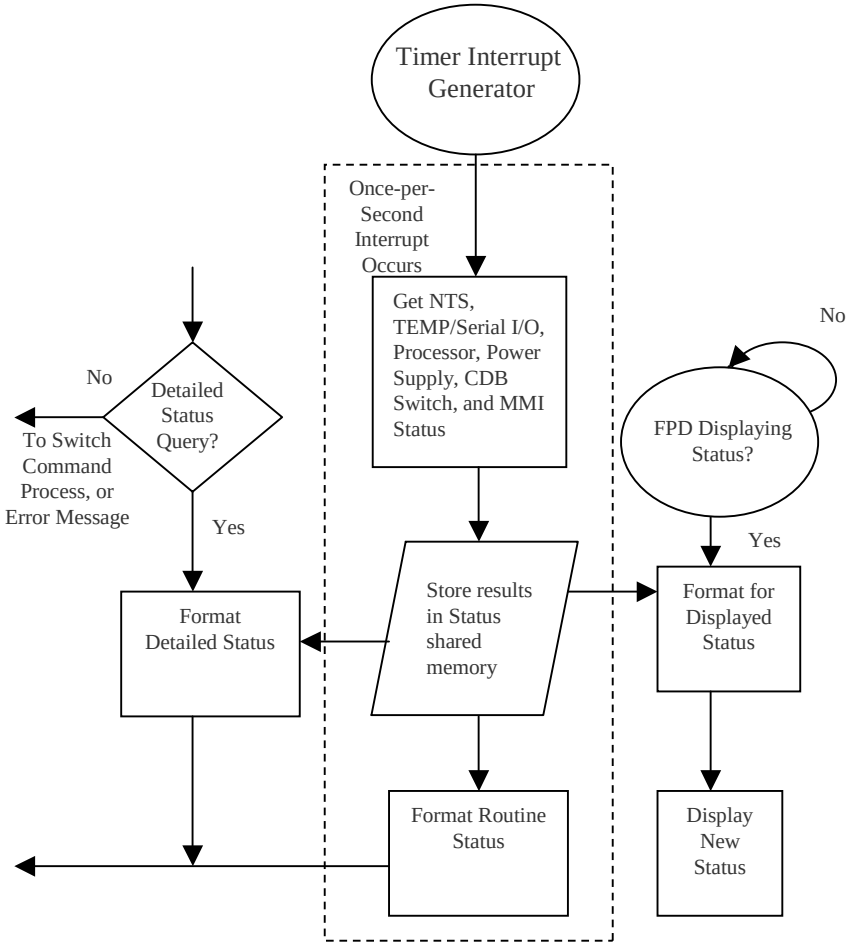
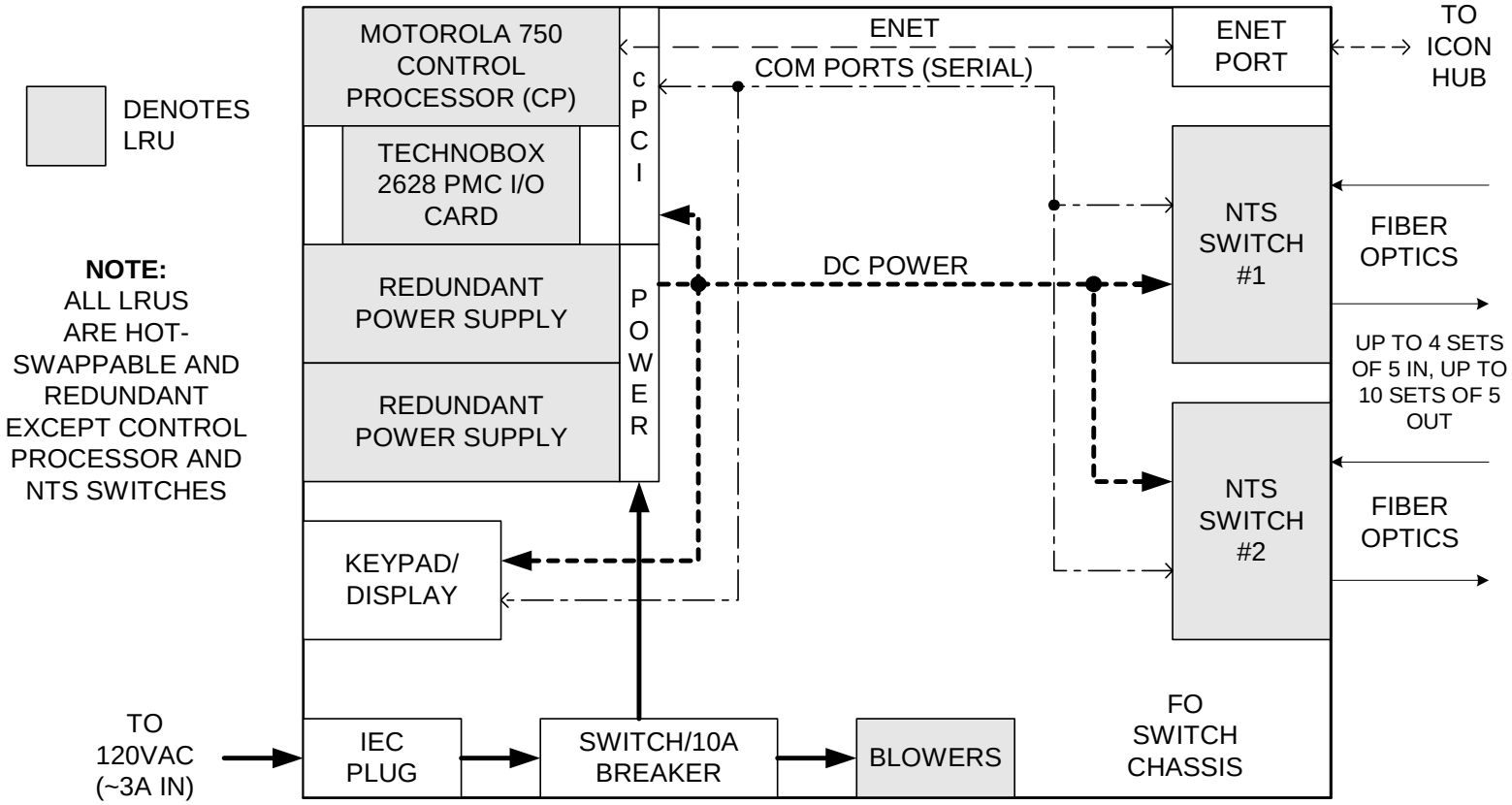
EMC Interface CI
Theory of Operation - Status

- All status is updated on a once- per-second basis
- Routine Status is sent to the ICON and updated on the FPD screen once-per-second
- Detailed Status is sent upon query from the ICON, and to the FPD screen as directed by the status menu displayed
- Status is stored in a shared memory to ensure that overwriting of valid status does not take place



Fiber Optic Switch

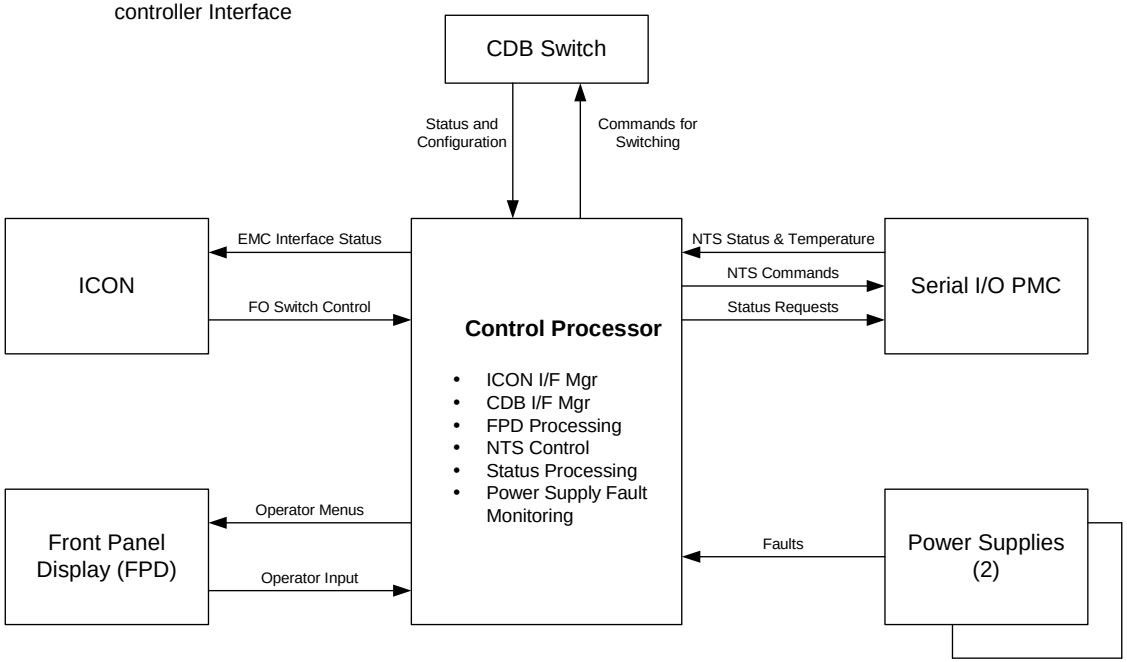
- Control Processor/ Serial I/O PMC
- Network Transparent Switches
- Fan Tray
- Chassis and Power



FO Switch Control Processor

- **FOS CP FIRMWARE**
  - Wind River Systems VxWorks Real-Time Kernel
    - Provides a low overhead, multi-tasking environment
      - Task Scheduling
      - Intertask Communications
      - Real-Time Event Support
    - Integrated Networking Facilities
      - Facilitates Development
      - Will be used for FO Switch/ICON controller Interface

- **MOTOROLA MCP750 cPCI SINGLE BOARD COMPUTER**
  - COTS Compact PCI (cPCI) Hardware Speeds Development
    - HW standard assures compatibility and availability of components
    - Redundant power supply status is monitored via cPCI FAL# line on backplane
    - Many cPCI components are common to the FO Switch, DMGs, and existing TBGFS Equipments



Serial I/O PMC

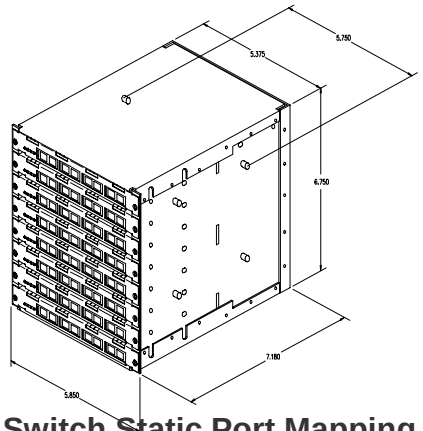
TECHNOBOX 2628

- **Serial I/O PMC is used for two functions:**
  - Temperature Measurement
  - Serial communications with NTS2 for Fibre Channel Control
- **Temperature accuracy is +/- 0.5 degrees C**
- **Serial I/O is available at the cPCI backplane for routing to the NTS**
- **Technobox 2628 is mounted in PMC slot of MCP750 Control Processor**

Network Transparent Switch (NTS)

- **Systran Fibre Channel Network Transparent Switch (NTS) is identical to that used in the EMC**
- **32 Port Device May Connect Any Input to Any Output**
  - Device Holds 8 Port Cards, Each with 4 input/output Ports
  - Used to Replicate and Distribute the Five 1.0625 Gbps Links
  - One-to-one or one-to-many switching
- **Provides Port Activity Information**
  - Useful in Isolating Failed Hardware
- **RS-232 Serial Port Provides for NTS Command and Status Interface**
- **Two NTSs provide 10 sets of outputs to IBUGs**

NTS SWITCH ASSEMBLY



FO Switch Static Port Mapping

E1.1IN/ I1.1 OUT	E2.1 IN/ I2.1 OUT	E3.1 IN/ I3.1 OUT	E4.1 IN/ I4.1 OUT
E1.2 IN/ I1.2 OUT	E2.2 IN/ I2.2 OUT	E3.2 IN/ I3.2 OUT	E4.2 IN/ I4.2 OUT
E1.3 IN/ I1.3 OUT	E2.3 IN/ I2.3 OUT	E3.3 IN/ I3.3 OUT	E4.3 IN/ I4.3 OUT
R/ I5.1 OUT	R/ I6.1 OUT	R/ I7.1 OUT	R/ I8.1 OUT
R/ I5.2 OUT	R/ I6.2 OUT	R/ I7.2 OUT	R/ I8.2 OUT
R/ I5.3 OUT	R/ I6.3 OUT	R/ I7.3 OUT	R/ I8.3 OUT
I9.1 OUT	I9.3 OUT	I10.OUT	I10.3OUT
I9.2 OUT	Spare	I10.2OUT	Spare

E1.4 IN/ I1.4 OUT	E2.4 IN/ I2.4 OUT	E3.4 IN/ I3.4 OUT	E4.4 IN/ I4.4 OUT
E1.5 IN/ I1.5 OUT	E2.5 IN/ I2.5 OUT	E3.5 IN/ I3.5 OUT	E4.5 IN/ I4.5 OUT
R/ I5.4 OUT	R/ I6.4 OUT	R/ I7.4 OUT	R/ I8.4 OUT
R/ I5.5 OUT	R/ I6.5 OUT	R/ I7.5 OUT	R/ I8.5 OUT
I9.4 OUT	I10.4OUT	I9.5 OUT	I10.5OUT
Spare	Spare	Spare	Spare
Spare	Spare	Spare	Spare
Spare	Spare	Spare	Spare

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FO Switch FPD Menus

- **Top Level FO Switch FPD Menus**
  - Mode/Control Select – Selection of FO Switch Operating Mode
    - Remote or Local Control Mode – Selects source of commands (ICON or FPD)
    - Note that FO Switch has no Online-Offline select (characterization as a single point-of-failure is incompatible with in-situ servicing)
  - Routine Status Screen - Displays all routine status parameters
    - Temperature
    - Switch Configuration
    - Go / No-Go Status for each LRU

- **Back Door FO Switch FPD Menus**
  - Switching Command
    - Identical to ICON switching operation
    - Switches CDB Switch in lock-step fashion
  - Detailed Status Menus - Individual LRU status parameters can be displayed

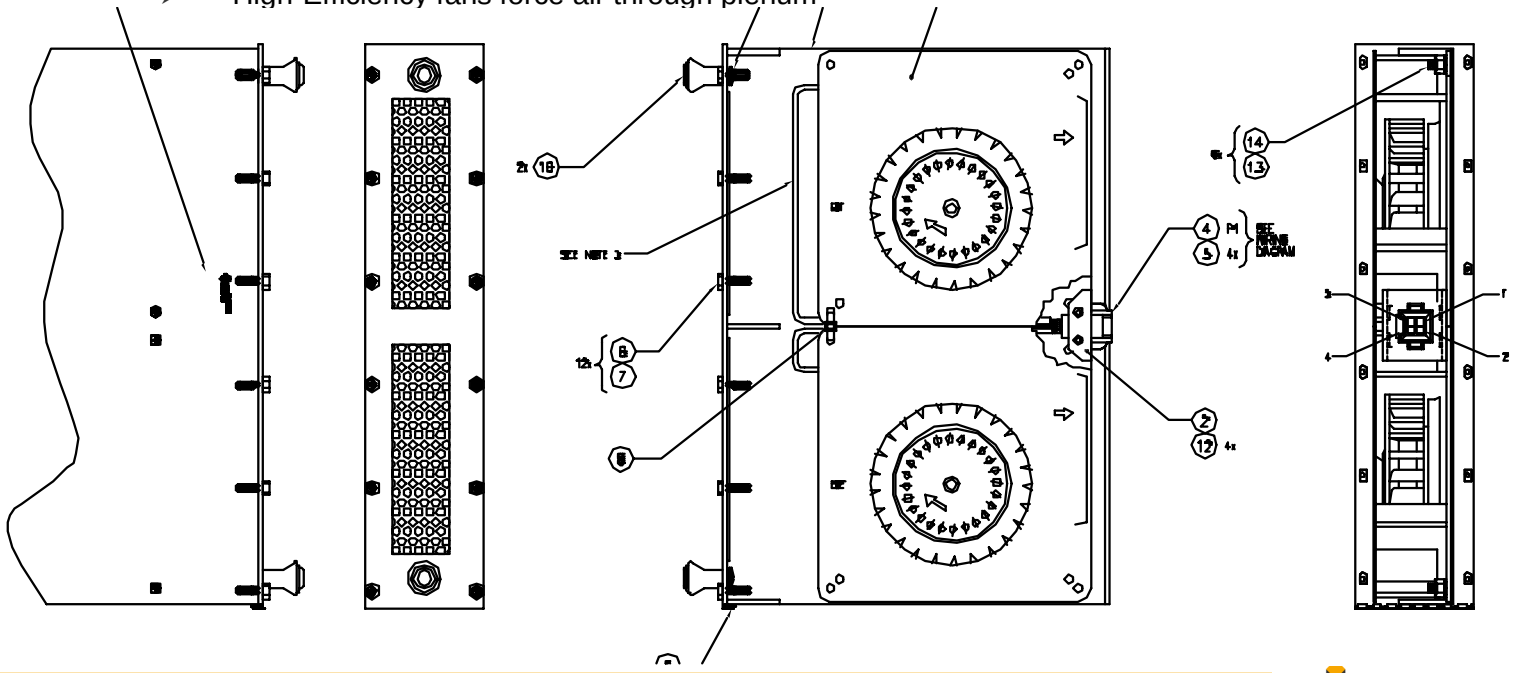
EMC Interface CI
Built-In-Self-Test (BIST)

- **EMC Interface Detailed Status Response is initiated on Power-up or when queried by ICON**
- **EMC Interface Detailed Status Reports the following status:**
  - NTS Communications Status
  - NTS Port Status and Signals Detected
  - NTS Port Switch Configuration
  - Keypad/Display Status (Communications established)
  - Serial I/O Communications Status
  - Serial I/O Temperature
  - MCP750 Status Including:
    - Communications
    - Presence of detected SW errors
    - Power supply fault
  - CDB Switch Status
  - CDB Switch Port Connections

Fan Tray

- **Fan Tray design has been modified for a high level of operational availability (FO Switch is a single point-of-failure for DAS)**

- **Hot-swappable Fan Tray Features:**
  - Blind Mating Connectors
  - Redundant Fans (failures sensed by temperature sensor on CP)
  - High-Efficiency fans force air through plenum



FO Switch Chassis and Power

CHASSIS

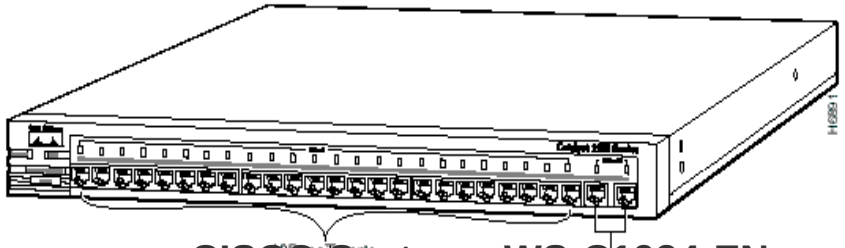
- Hot-swappable fan tray and power supplies
- Many chassis components common with IBUG, DMG, and EMC Chassis
- 10A circuit breaker integrated into AC switch
- Keypad and display for local control and service

POWER

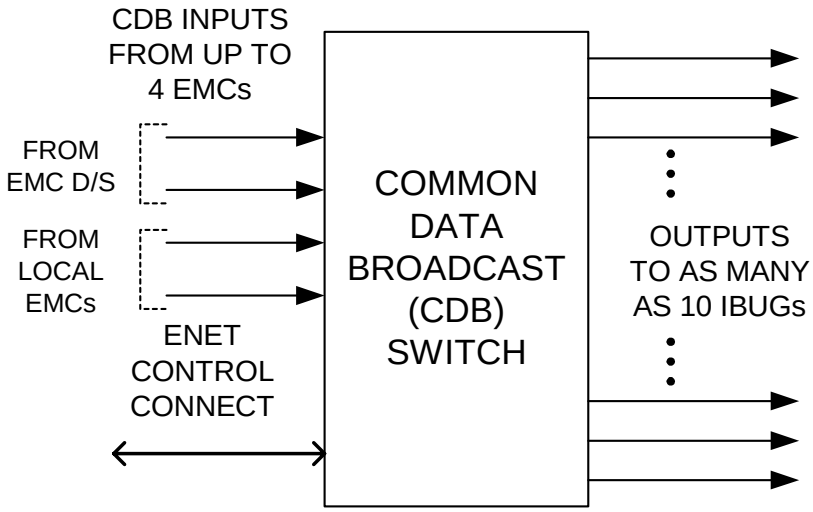
- Highest Power Density Available:
  - Up to:
    - 60A @ 3.3VDC
    - 60A @ 5VDC
    - 5A @ 12VDC
    - 0.5A @ -12VDC
- Conforms to cPCI Standard
- Supplies are redundant and diode coupled
- 105 to 132VAC, 47 to 63 Hz
- FCC Class A compliant

Common Data Broadcast (CDB) Switch

- Cisco Systems 1924 Ethernet Switch
- 1924 Device is used for both CDB Switch and Data Switch (between DMG and DSER) to facilitate sparing
- Virtual LANs enable the CDB Switch to send broadcast packets from EMC(s) in a one-to-one or one-to-many format
- I/O assignments made by ICON through FO Switch Interface



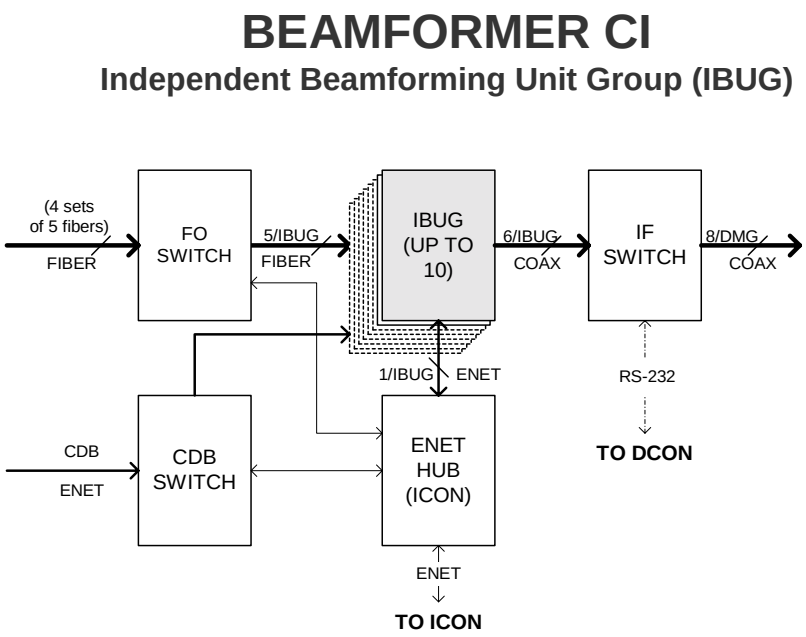
CISCO Systems WS-C1924-EN



CDB SWITCH INTERCONNECTS

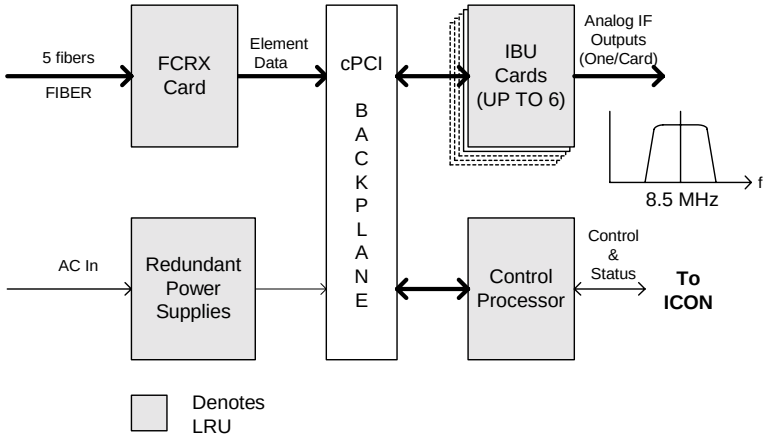
Beamformer CI

- **Accepts EMC Fibre Channel Element Data, applies weights and forms into a single analog composite signal**
- **Controlled by ICON**
- **Up to 10 IBUGs can be installed per site to accommodate expansion**
- **Complies with SRD Requirements for:**
  - Beamforming (Para. 3.1.3.1)
  - Systems requirements for status generation (Para. 3.1.7) and operations control (Para. 3.1.8)
  - MAR Beamforming Performance requirements (Para. 3.2.3)
  - Other operational and performance requirements consistent with overall DAS mission



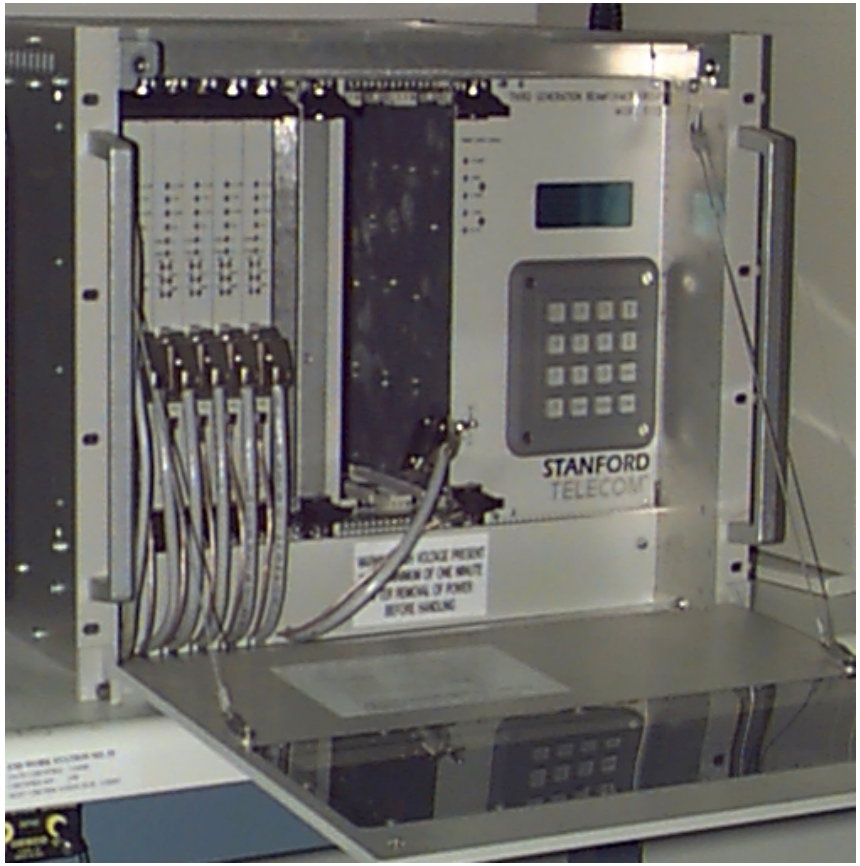
Beamformer Functional Description

- **IBUG Control Processor (ICP)**
  - Provides Configuration, Control, and Status for all IBUG Hardware
  - Generates Beam Weights for Each IBU
- **Fibre Channel Receiver Boards (FCRXs)**
  - Convert 1.0625 Gbps Serial Links to 53.125 MHz Parallel Data
  - Recover 53.125 MHz Clocks
- **Individual Beamforming Units (IBUs)**
  - Each IBUG May Contain Up to six IBUs with Transition Modules
  - Generate Formed Beams by Weighting Element Channel Data and Combining
  - Convert Digital Data Streams to Analog and Up-Convert to User-Specified IF



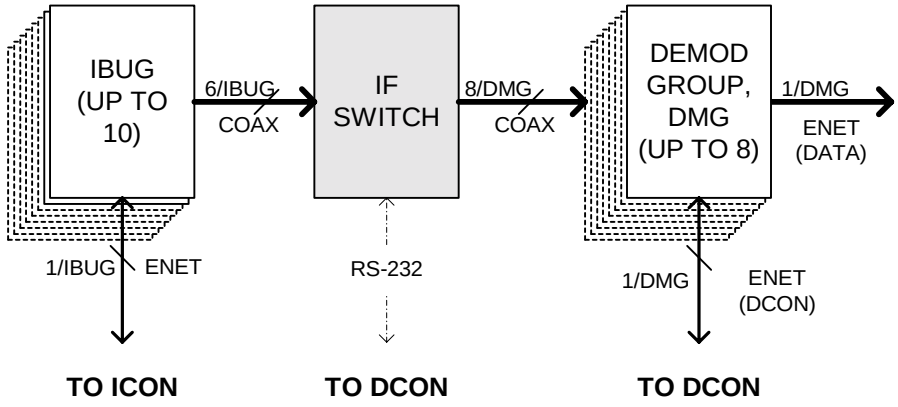
Proven COTS Component

- Meets or exceeds SRD requirements
- COTS purchase simplifies design and testing
- Demonstrated interoperability with other DAS components
- FCC Class A Compliant



IF Switch CI

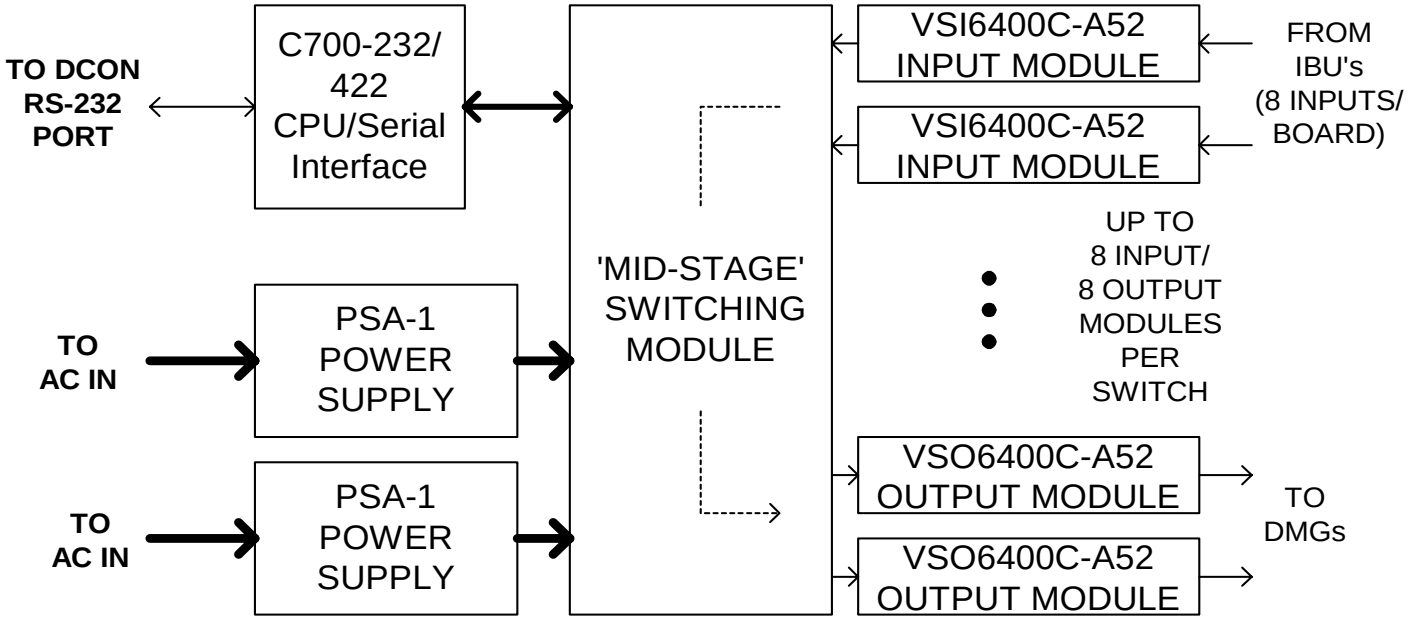
- **Universal Switching Corp. Model S6400C-11-305HA (COTS Product)**
- **RS-232 (remote from DCON) and front panel (local) control**
- **Hot-swappable I/O cards and Power Supplies**
- **Functional**
  - Provide non-blocking one-to-one and one-to-many switch connectivity between IBUs and demods
  - Switch dynamically under command from DCON
- **Key Drivers**
  - Provide 64x64 non-blocking connectivity
  - Impart minimal signal distortion
  - +/- 1 dB gain linearity over the frequency range of interest



IF SWITCH CI

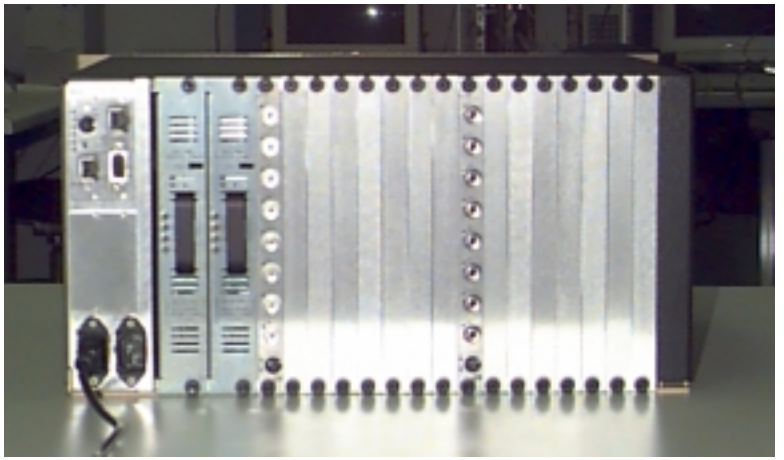
IF Switch
Theory of Operation

- External Commands from DCON Select Connectivity
- Internal Switching Module ports desired inputs to outputs
- Redundant/Hot Swappable Power Supplies and extra Input/Output Modules allow the IF Switch to provide a high degree of availability



IF Switch BIST

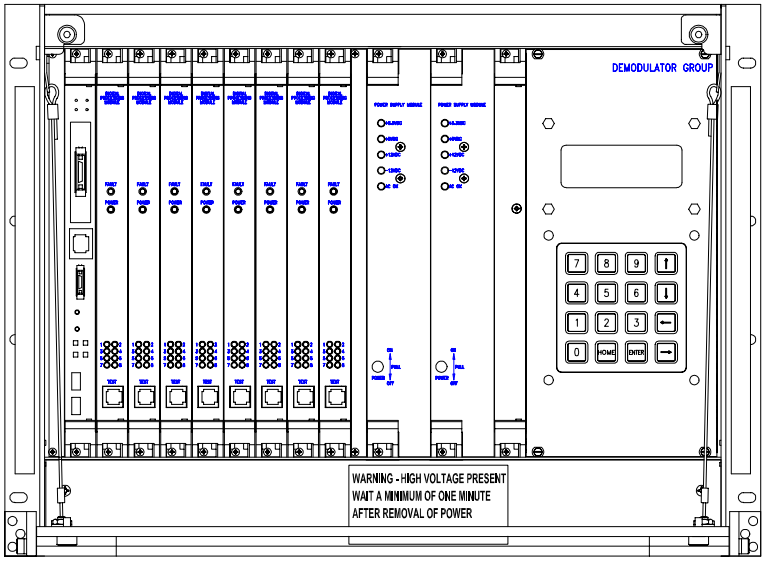
- **IF Switch's built-in intelligent controller does a BIST at power up and as requested by the operator.**
- **Routine Failures of the following IF Switch Components are detected using the 'STAT' command:**
  - RAM/ROM
  - KEYPAD/Display/LED's
  - Quantity, size, and type of all plug-in cards
  - Power Supply operation and supplied voltage levels
  - Internal CPU Functions
- **Error messages are provided to DCON over the serial interface**
- **Device MTBF is 75,000 Hours**



Demodulator Group (DMG) CI

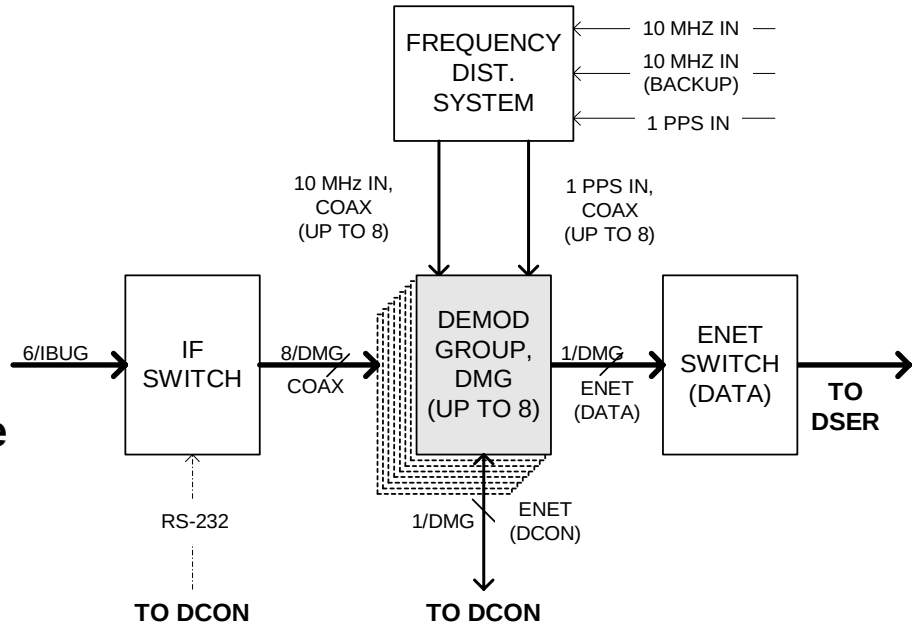
KEY DMG REQUIREMENTS

- Failure detection and isolation to the LRU level
- Supports up to 8 user data channels in an 8U x 19 inch wide chassis
- Redundant, Hot-swappable Power Supplies for high availability
- Support all DG1 Mode 2 MA Return Link signal configurations
- Support frequency ranges and uncertainties due to spacecraft orbit and oscillator drift
- 2 dB implementation loss



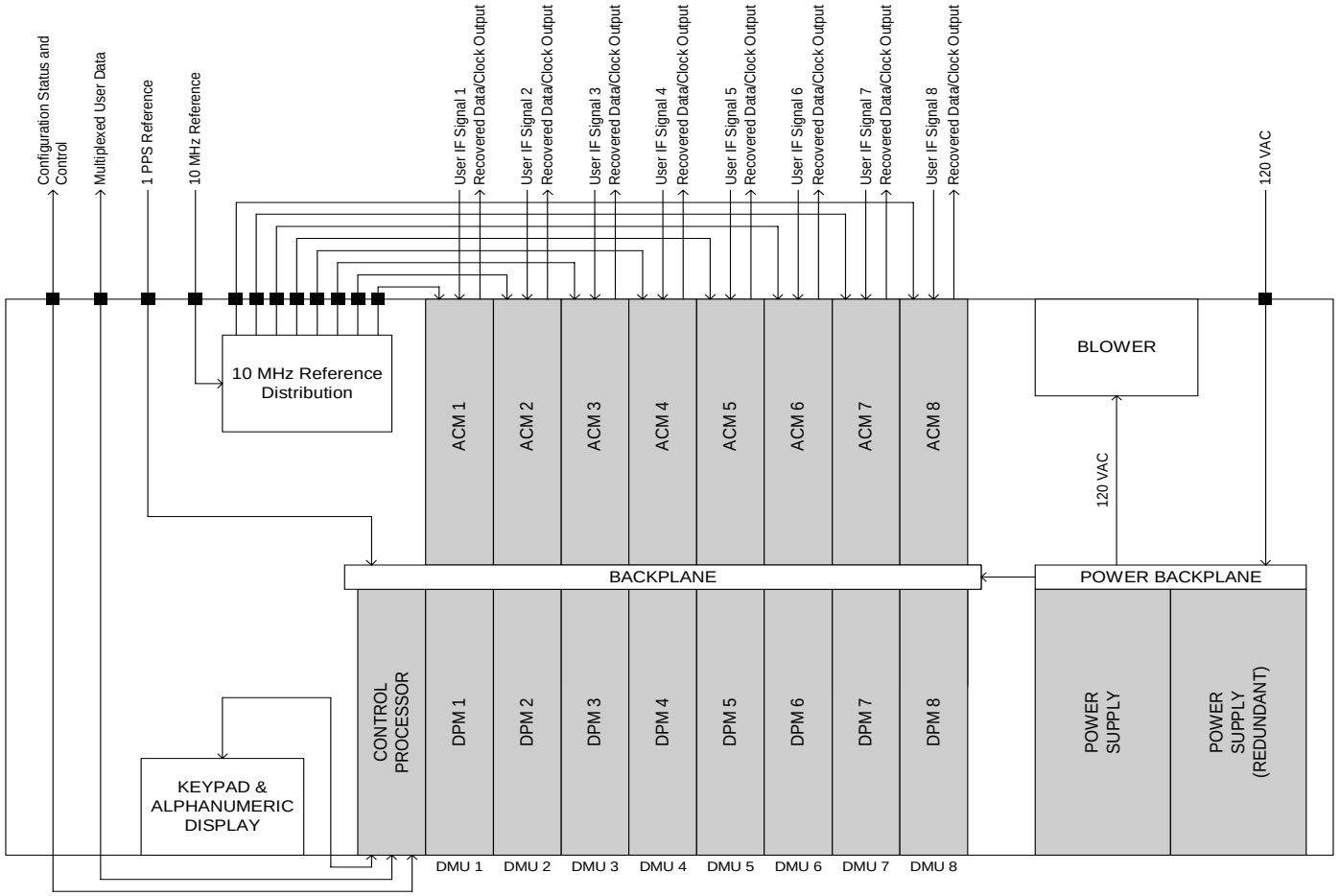
Key DMG External Interfaces

- DCON- remote status, command and control
- Front Panel Display (FPD)- local status, command, control
- IF Signals- Data modulated signals from IBUG/IF Switch
- DSER- recovered user data
- Frequency and Timing reference signals- assists in acquisition & tracking of orbital user
- Power- 120 VAC
- Front Panel LEDs

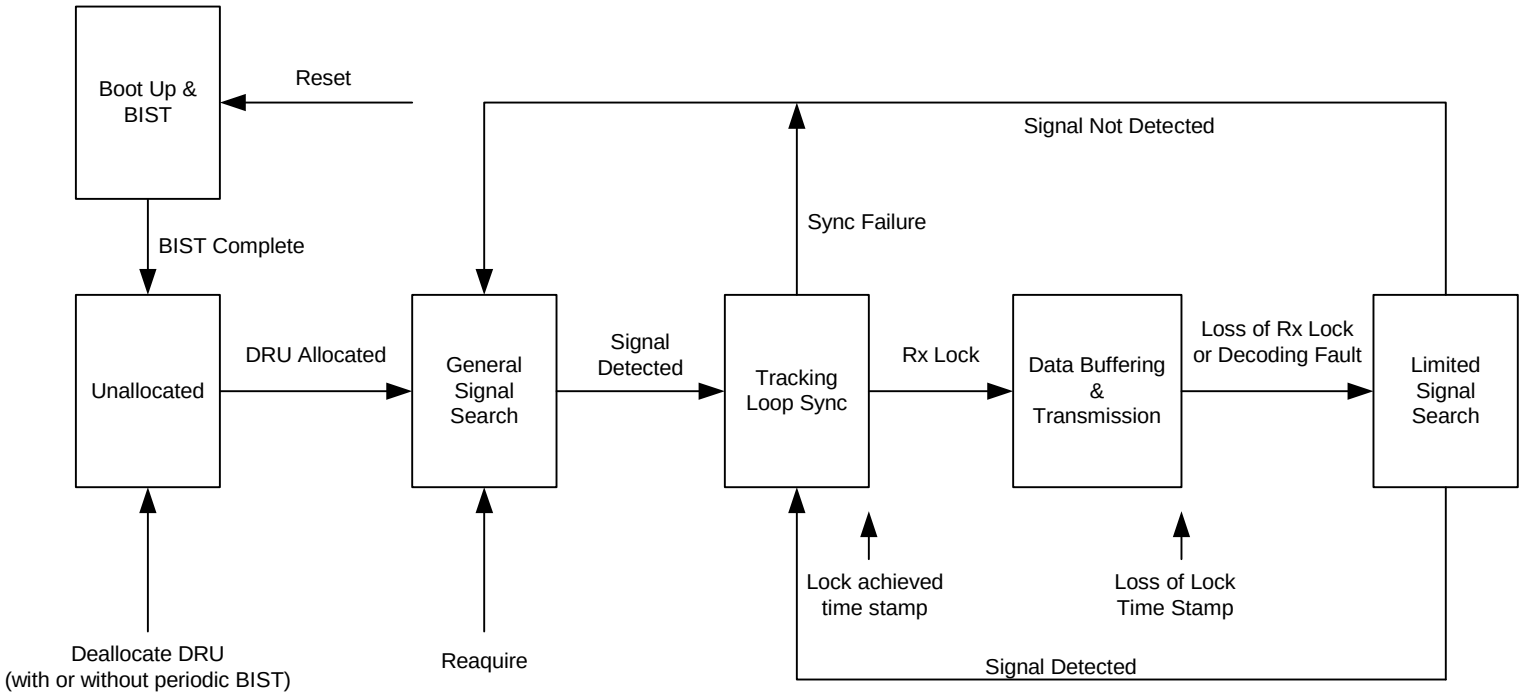


ITT Industries
Engineered for life

DMG Block Diagram

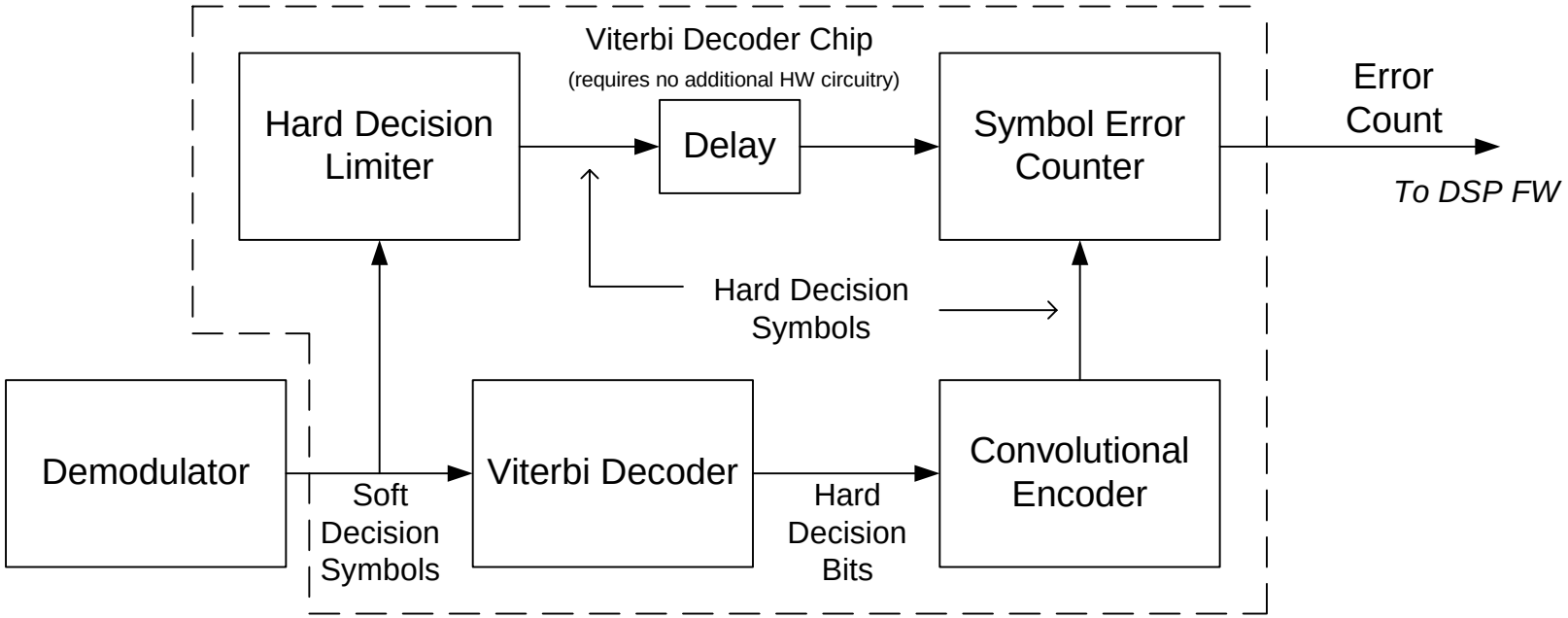


DMU State Diagram



Decoding Fault Detection

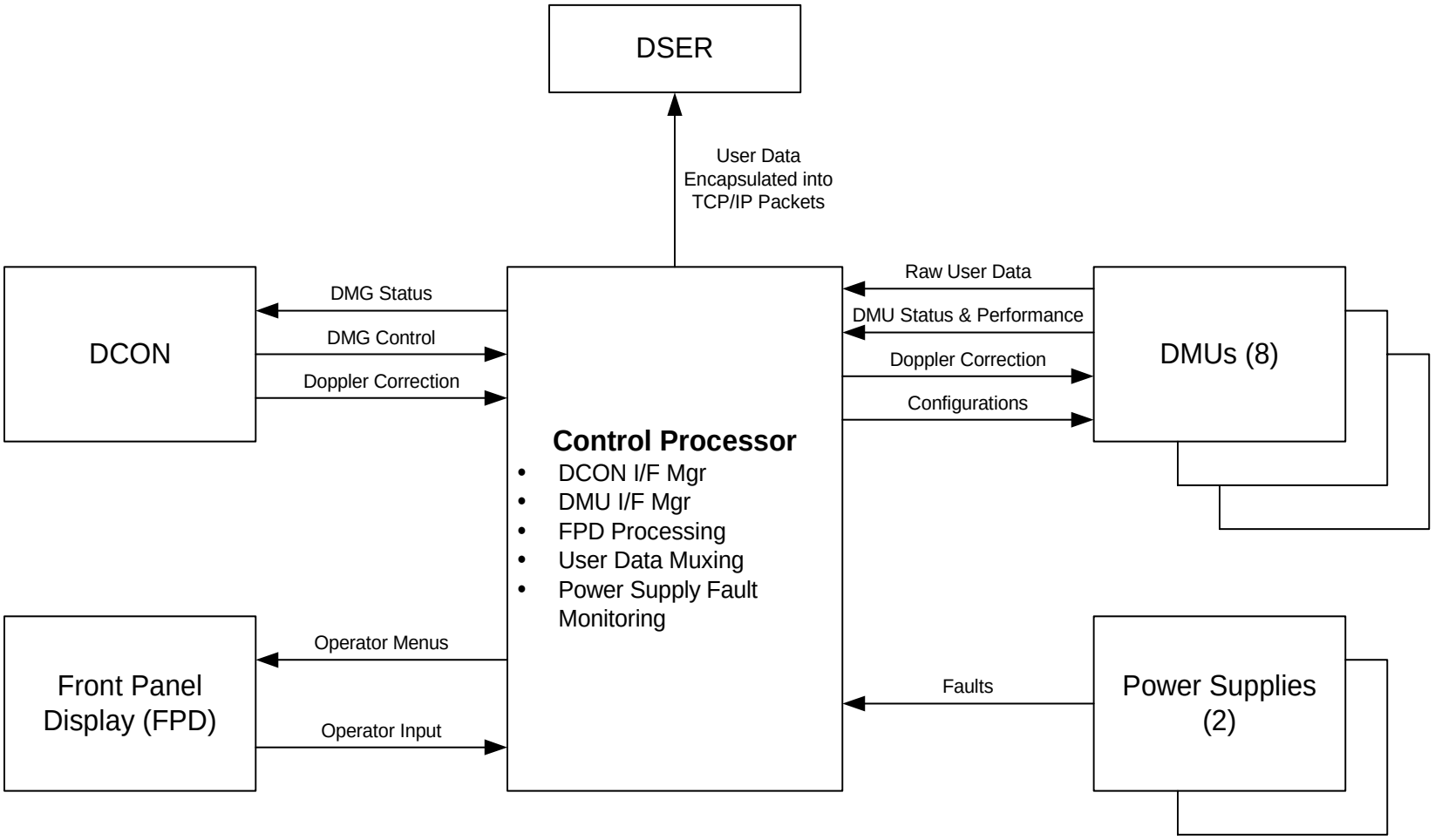
- **Detects data corruption due to configuration errors or misalignment of G1/G2 symbols**
- **Count the number of symbol errors over a sequence of 1000 symbols**
  - If over 400 errors, the data is declared to be “corrupted”
  - Probability that corrupted data is declared “good”: less than 1%
  - Probability that good data is declared “corrupted”: essentially zero



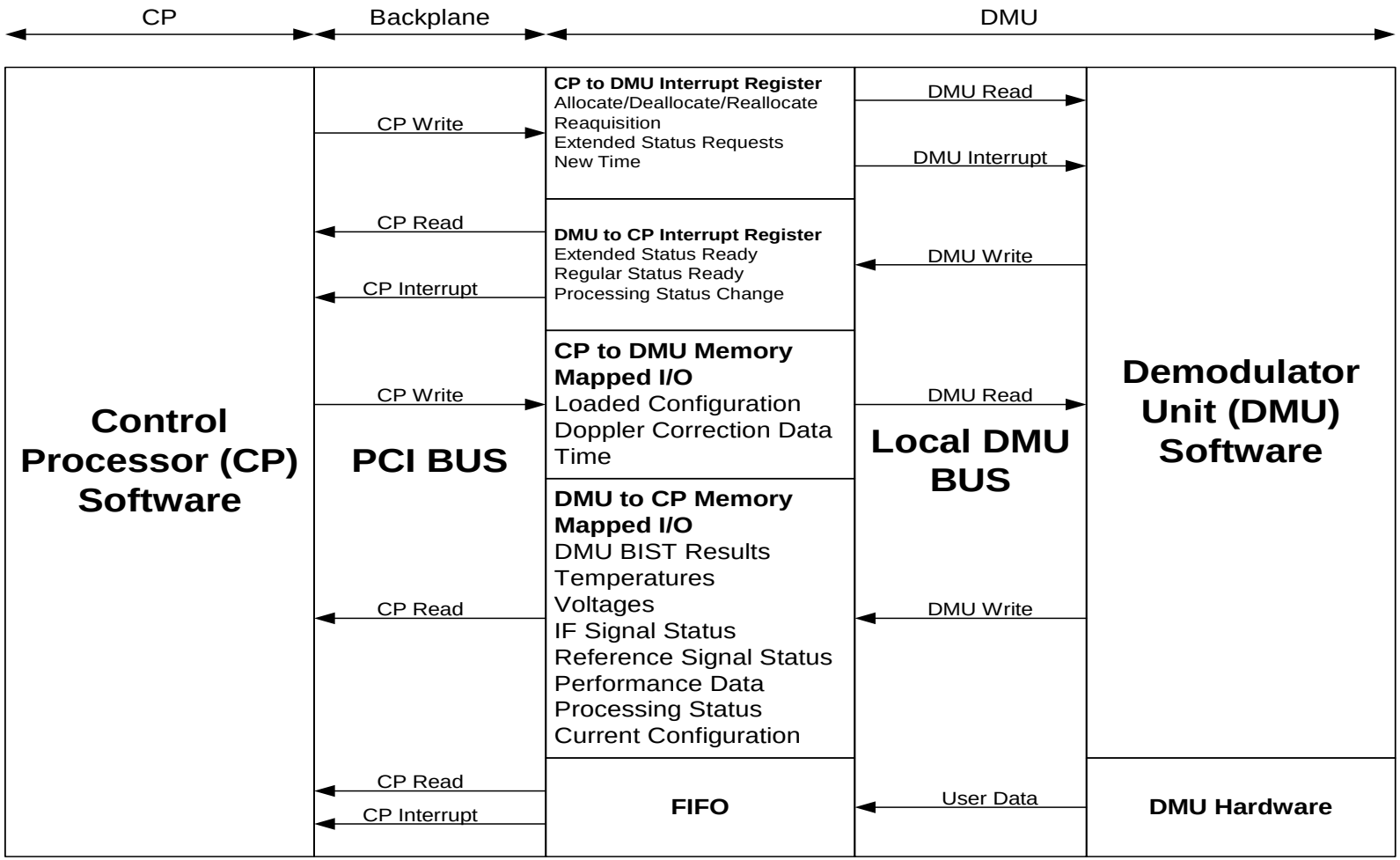
DMU Configuration Parameters

DMU Configuration Variable	Range of Values
DSER Port Number	5000-5100
Data Rate	1000-150000 b/s
Modulation	BPSK or SQPN
PN Code (if BPSK)	256 byte sequence (2047 bits)
I PN Code (if SQPN)	256 byte sequence (2047 bits)
Q PN Code (if SQPN)	256 byte sequence (2047 bits)
G2 Inversion	Upright or Inverted
Symbol Format	NRZ or Biphase
Data Format	NRZ-L, M, or S
Acquisition Mode	A or B
Initial Carrier Frequency Offset	plus/minus 200 kHz
Initial Doppler Rate	plus/minus 200 Hz/sec
BIST	Single Shot or Periodic
Data Port	Symbols or bits
DSER Data	bits or symbols (1,2,4, or 8 bits)

Control Processor Block Diagram



CP/DMU Interface



DMG Front Panel Display (FPD) Menus

- Mode/Control select- Selection of DMG operating mode (offline or online) and control mode (remote or local)
- General DMG Status- go/no-go summaries of BIST, IF & reference signals, PCI connections, temperature and voltage, and processing status (deallocated, searching, locked) for all DMUs
- DMU Status Screen- displays performance data when DMU is in lock
- DMU Configuration- see DMU Configuration Parameters chart for list of DMU configuration variables

DMG Control and Mode Definitions

- **DMG Mode- Online/Offline**
  - Associated with signal flow through DAS
  - Online- signal flow passes through
  - Offline- signal flow between DMG and DSER is cut off, even if some or all DMUs are actively recovering data
  - If DMG is “offline” all DMUs are offline; if DMG is “online”, DMUs can be selectively placed online or offline

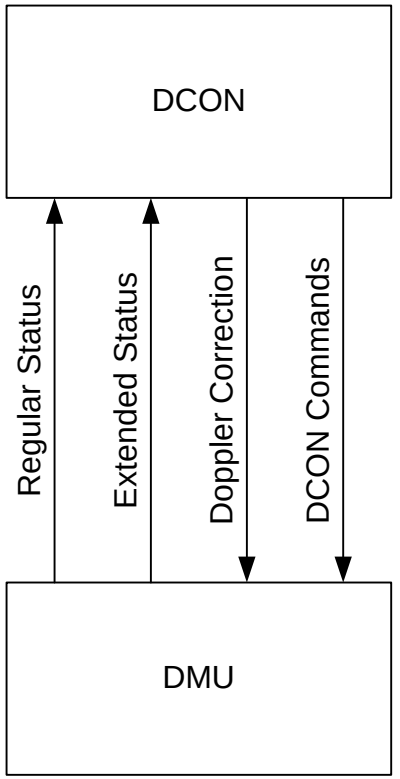
- **DMG Control- Local/Remote**
  - Associated with source of command and control of DMG and DMUs
  - Local- FPD is the command and control source
    - Limited number of DCON commands (e.g, status requests) recognized by DMG
    - Doppler correction disabled when “local”
  - Remote- DCON is the command and control source
    - Limited number of FPD commands recognized by DMG

“Back Door” FPD Menus

- **SET**
  - Remote/Local Control
  - Online/Offline Mode
  - DMU Configuration
  - DMG & DSER IP Addresses
  - Time
- **VIEW**
  - Signal Connectivity
  - SOH Data
  - Performance Data & DMU Operation
  - DMU Configurations
  - CP & DMU BIST Results
- **COMMAND**
  - Allocate
  - Reallocate
  - Deallocate
  - Reacquisition

DCON Interface

- **DCON recieves periodic, “regular” (once per second) status messages from each DMG every second**
  - DSER IP Address, DMG Mode, DMG Control, LRU condition (go/no-go), DMU connection and processing status
- **Commands sent from DCON to DMG**
  - Extended status request, DMU configuration, allocate, deallocate (with or without a periodic BIST), reacquisition, and current time (for Doppler Correction)
- **DMG response to extended status request**
  - Request made on a “per DMU” basis
  - Temperature, voltage, IF and reference signal connectivity, performance data

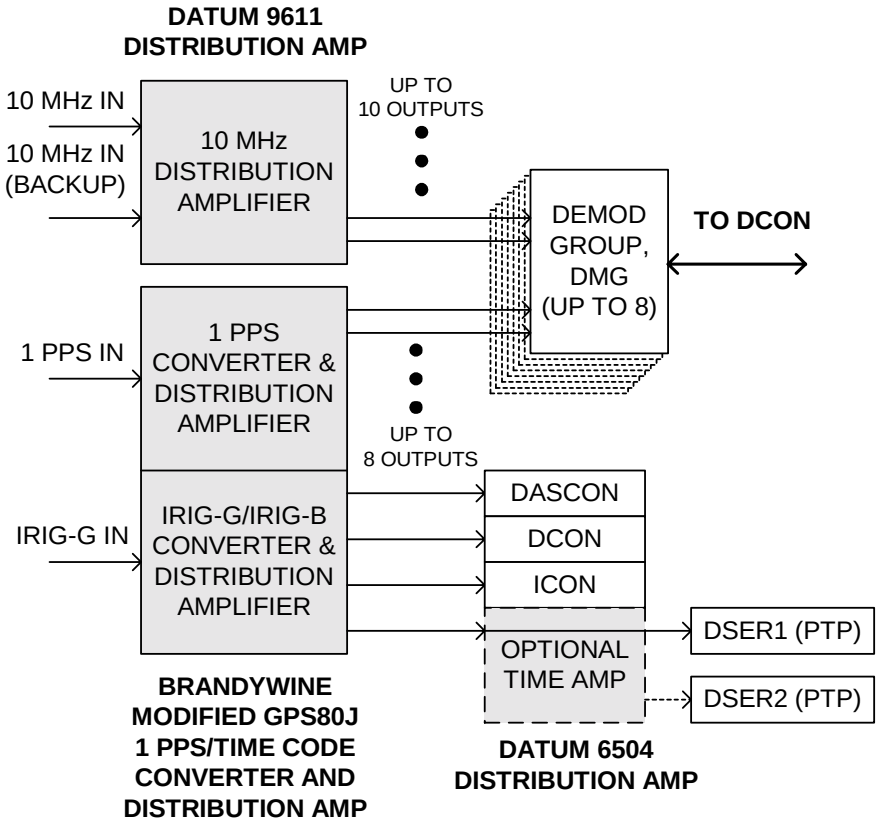


BIST and Signal Monitoring

- **Control Processor BIST**
  - Control Processor software and memory
  - Power Supplies
  - PCI Interface
  - DMU/CP Connectivity
  - DCON Interface
- **DMU BIST**
  - PCI Bridge Configuration
  - SHARC and PMC memory
  - Access to FPGAs, Viterbi Decoder, DDS chips, and Temperature sensors
  - IF and reference signal connectivity
- **Control Processor State of Health Monitoring**
  - DMU Temperatures
  - DMU Voltages
  - Power Supplies
  - IF and reference signal connectivity
  - DMU/CP connectivity

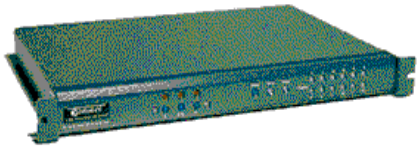
Frequency and Timing CI

- **Provides reliable timing and frequency inputs to DAS components**
- **Three Primary Components**
  - 10 MHz Distribution Amp
  - 'Modified' GPS80J 1 pps/IRIG Time Code Converter/Amp
  - Optional Time Code Amplifier used for distributing IRIG-B Time Code to second PTP (as needed)
- **Redundant 10 MHz input ensures receiver frequency tuning is reliable**
- **1 pps used for Doppler correction**

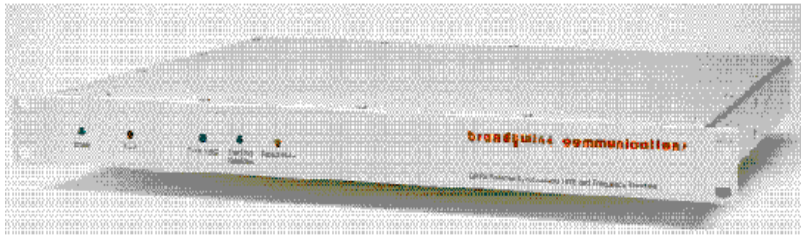


Frequency and Timing Components

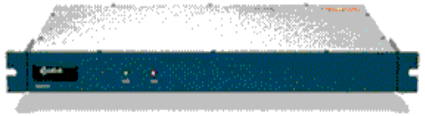
- **10 MHz Distribution Amplifier**
  - Datum 9611
- **IRIG-G/IRIG-B and 1 pps Converter/Amplifier**
  - Brandywine GPS80J is factory set for IRIG-G to IRIG-B conversion and purchased with 4 IRIG-B outputs
  - Device is factory modified to convert 1 pps input from 'special' RS-422 to traditional TTL 1 pps for distribution to DMGs
- **Time Code Distribution Amplifier**
  - Datum 6504
  - Used at WSC installation only when a second PTP is required (Not provided w/initial install)



Switch & Distribution Unit



Modified GPS80J

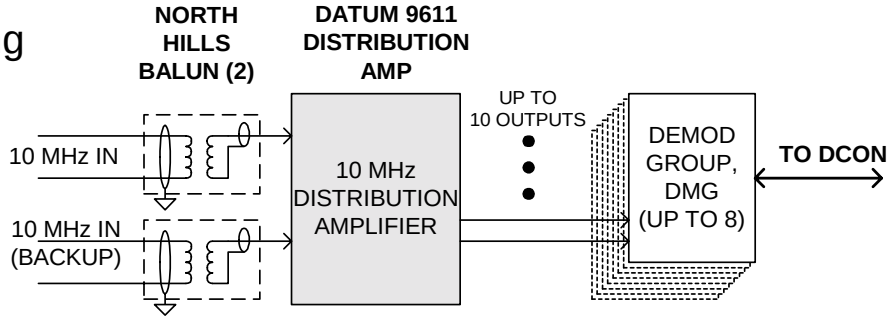


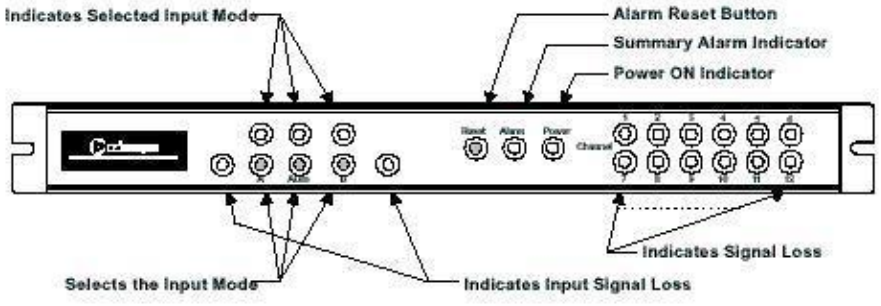
Datum 6504

10 MHz Distribution Amplifier (COTS) Functional Description

- **Redundant Inputs**
  - Input Baluns convert input signal from balanced to single-ended format
  - One-to-one, one-to-many switching
- **Indicators**
  - LEDs for:
    - Input signal present
    - Output signal Present
    - Power on and Alarms
- **Pushbuttons**
  - Switches for hard selection of inputs, configure for auto-switching, or reset box.

Note: All failures sensed by DMGs only (RS-232 remote control not used)

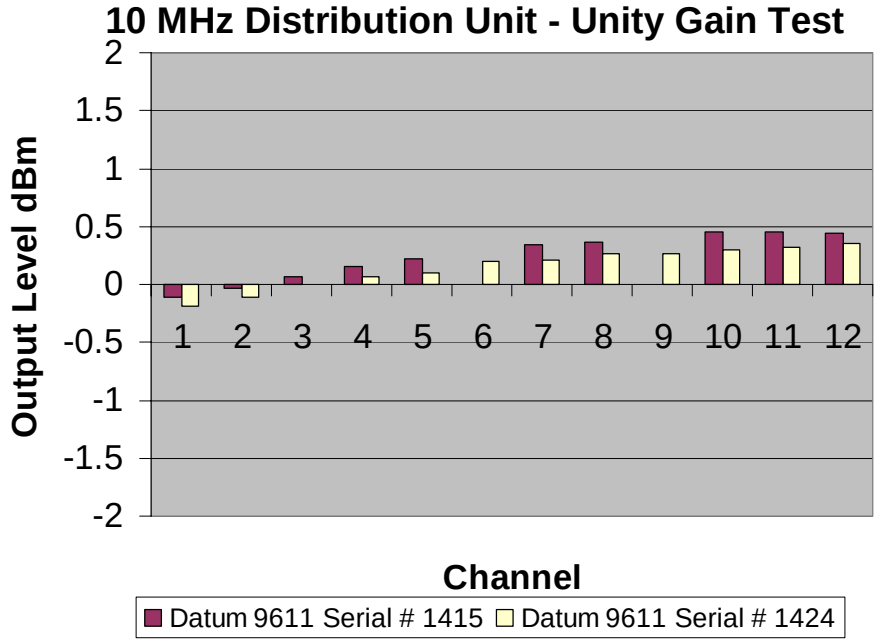




DATUM 9611 Indicators and Controls

10 MHz Distribution Amplifier Test Performance

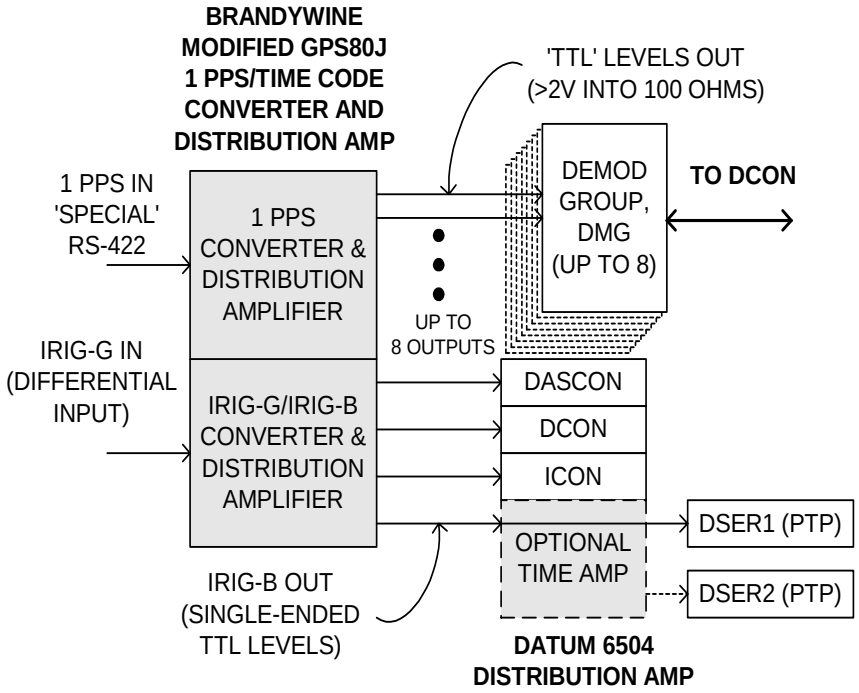
- **Outputs consistently provide unity gain +/- 0.5 dB**
- **LED's performed as expected**
  - Green = connected and valid
  - Red = disconnected or invalid
- **Switching time is >150 ns, may adversely affect DMG performance – evaluation proceeding**
- **Pushbutton control sequence not automatic – guidance on resetting after 10 MHz input fault will be provided on rear door of associated rack**



Modified GPS80J IRIG-G/IRIG-B Converter and 1 pps Distribution Amp

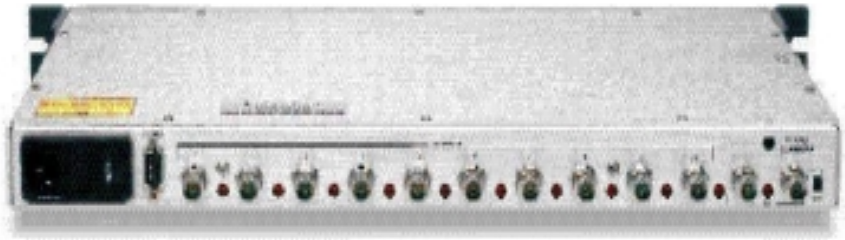
- **IRIG-G to IRIG-B Converter and Distribution Amplifier**
  - Up to 4 outputs
  - 'TTL-Level' signal outputs are single-ended
  - Accepts differential input IRIG-G signals over Twinax input cable

- **1 Pulse-Per-Second (pps) Converter and Distribution Amp**
  - Converts 'Special' RS-422 (0-2.2V) into single-ended 'TTL' levels
  - Up to 8 outputs (one per DMG)
  - Minimal propagation delay (< 100 ns)



New Component: IRIG-B Distribution Amplifier

- **Datum 6504 Distribution Amp**
  - Used ONLY when second PTP is added to DAS system (>24 users)
  - Accepts IRIG-B input and distributes to up to 10 outputs
  - LED status monitoring on all inputs and outputs



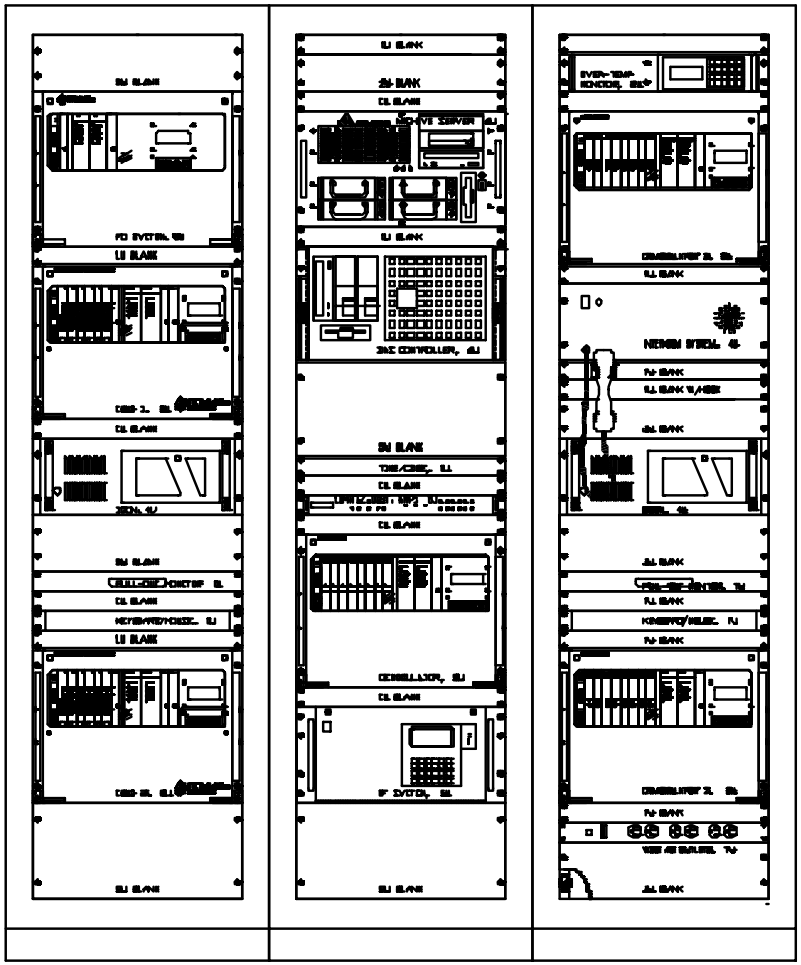
- **Fault Detection**
  - IRIG-B signal loss is detected from both the Modified GPS80J and the 6504 Distribution Amp by the SyncClock32 IRIG-B cards housed within DAS controllers

Mechanical and Power CI

- **Mechanical and Power CI includes all mechanical parts and related components that are not associated with any other CI such as:**
  - Temperature Monitor and sensors
  - STDN 270.5 Racks
    - Racks
    - I/O 'Doghouse'
    - Rack installation HW
      - Slides
      - Rails
      - Cable Retractors
      - Balun/KVM rail
  - Cables
  - Ethernet Components
  - Printer
  - Workstation Desk

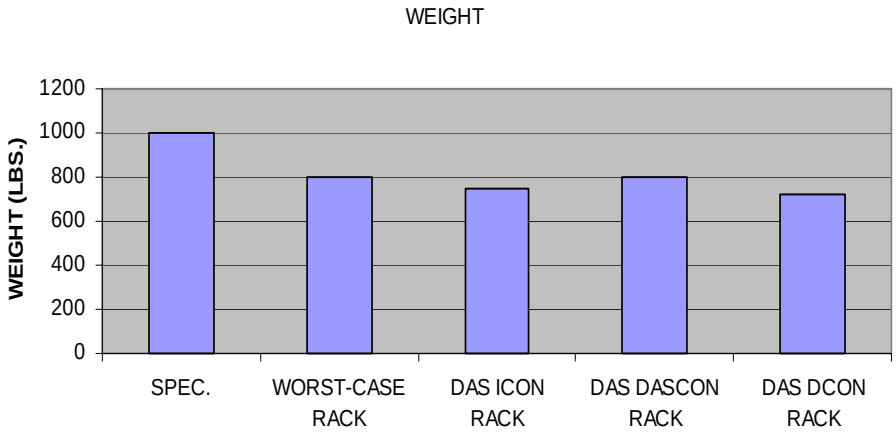
Mechanical and Power CI Requirements and Interfaces

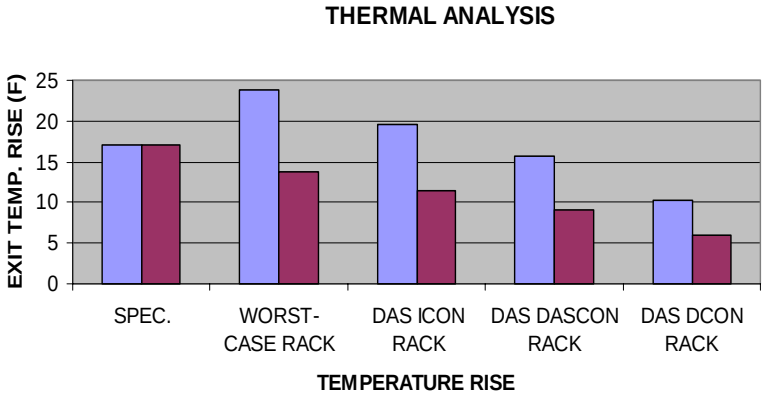
- **Physical Requirements**
  - Weight Less than 1000 lbs.
  - Power less than 75% of supplied ac service (20A)
  - Temperature rise less than 17 degrees F.
- **Conform to Specifications**
  - STDN 270.5 racks
  - STDN Spec 8 and 530-LOP-WSC compliant cables
- **Temperature Monitor/Sensor**
  - Send warning at 115 Degrees F
  - Send alarm at 125 Degrees F
- **Ethernet Components**
  - Highly reliable
  - High speed switching capability

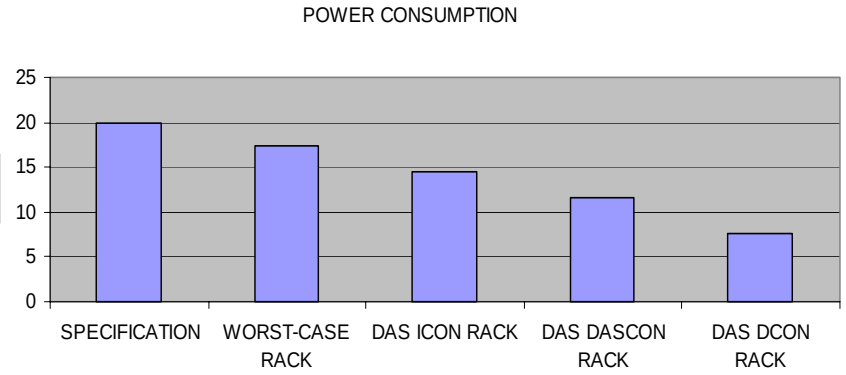


Weight, Power, and Temperature Update

- **Weight**
  - All racks less than 1000 lbs.
- **Power**
  - All racks use less than 75% of available 20A, except future IBUG racks which will require 2 ac services per rack
- **Temperature Rise**
  - All racks will use a top vent to dissipate heat





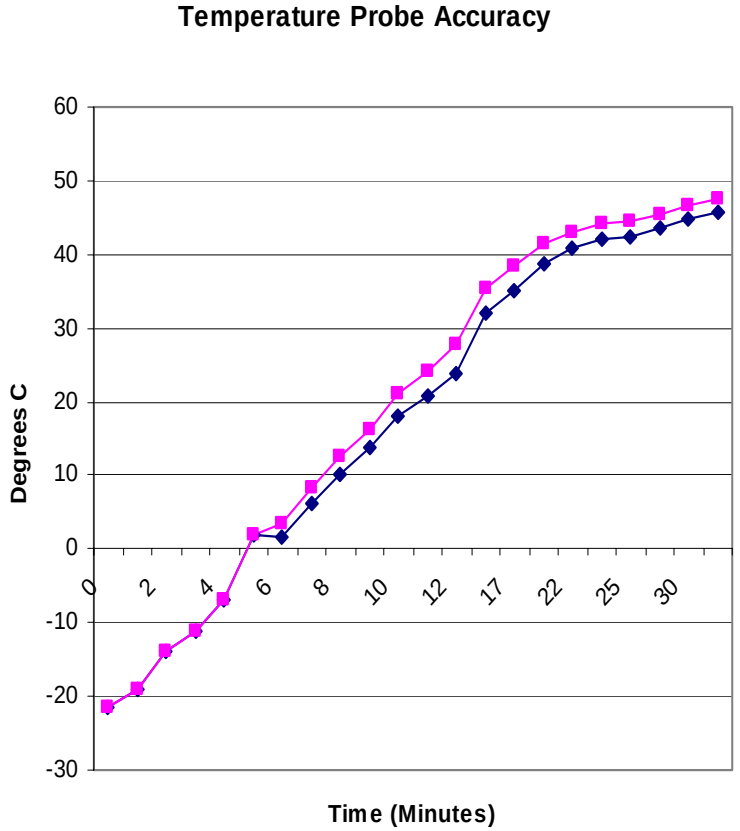


Temperature Monitor and Sensors

- **Lakeshore Model 218 Temperature Monitor**
  - Monitors up to 8 channels (one sensor per rack, with a dedicated sensor for inlet temperature monitoring)
  - Four-wire sensing compensates for connector and wiring resistance losses
  - Convenient rack-mount kit
- **Model DT-471 Sensors**
  - Nominal +/- 0.5 degree C accuracy possible
  - Calibration curves shipped with Model 218 Monitor
  - Package size and shape simplify mounting

Temperature Monitor/Sensor Test Performance

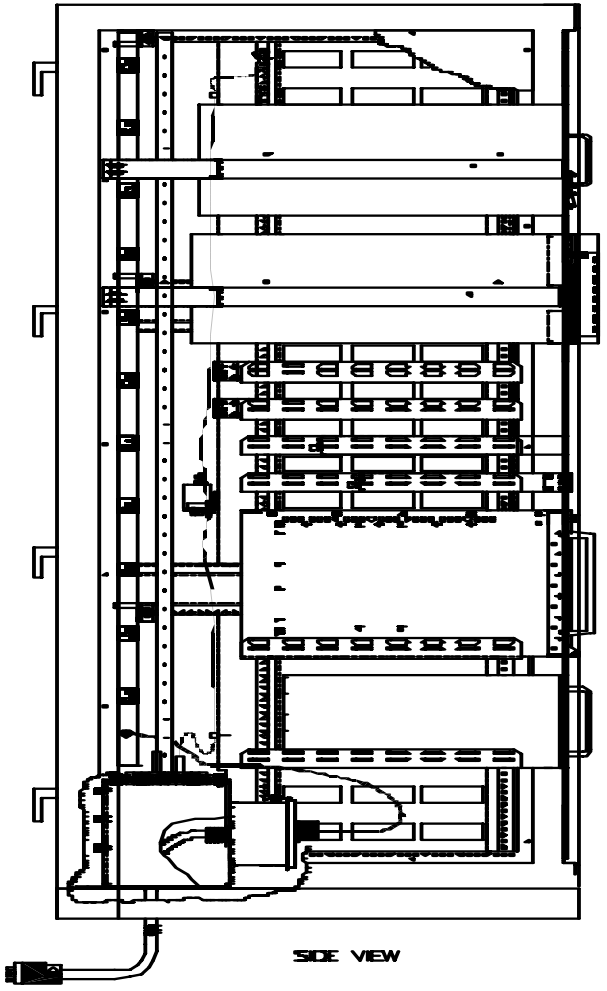
- **Temperature Monitor/Sensor combination tested for:**
  - Absolute accuracy
  - Effects of cable length (60' cable length tested w/deliverable cables)
- **Test Results**
  - Absolute accuracy is +/- 2 degrees
  - Probes tracked evenly across the temperature range
  - Cable length effects were insignificant



Graph shows measured data collected 1/23/01 in Thermotron Temperature Chamber at ITT Reston. Data shows 60' measured temperature (squares) vs. 10' cable length (diamonds). Probes were co-located in the chamber

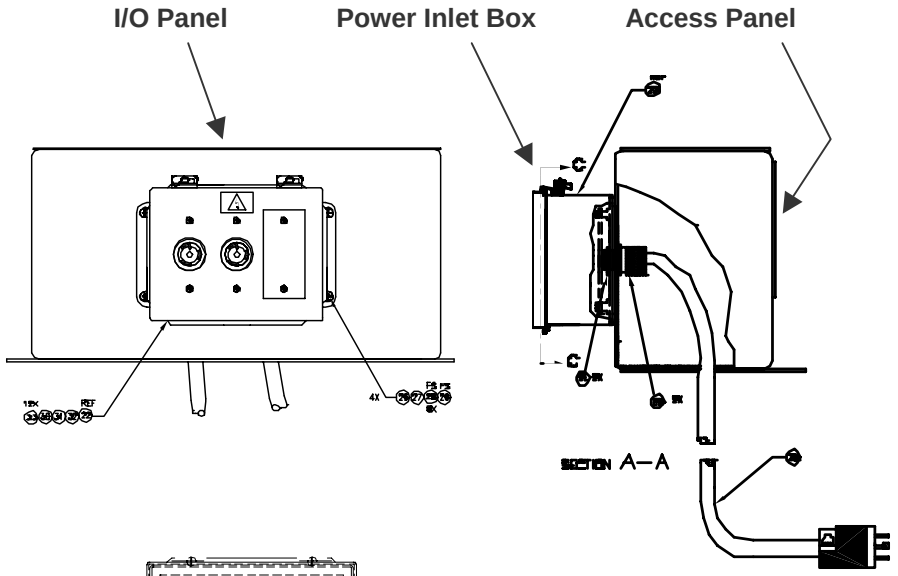
Rack Details and I/O

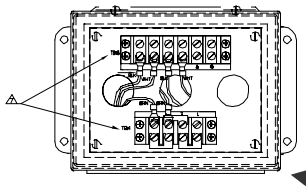
- **Refer to Attachments showing:**
  - Initial Installation at WSGT
  - Initial Installation at GRGT
  - Future 'Growth' Option installation at WSGT
  - Future 'Growth' Option installation at GRGT
- **DASCON, PTPs, DCON and ICON are mounted on slides w/Cable Retractors all other equipment mounted on shelv**
- **All power from site is routed through power inlet box to ac power strip**
- **Cables conform to STDN SPEC-8**
  - Labeled per 530-WSC-LOP-VII
  - All intra-rack cables routed through I/C panels except IF Switch RF cables, which are routed directly in rear of cabinet



“Doghouse” Box and Power Inlet Box

- **Doghouse Box**
  - Located in bottom rear of each rack
  - I/O Panel on top holds feed-through connectors for all I/O’s
  - Access Panel assists operators with bottom connections
  - Panels remove with “hand-tighte captive fasteners
- **Power Inlet Box**
  - Handles inputs from site power
  - Terminal block mounted within the power inlet box for wiring to ac outlet strip or convenience panel
  - Twist-lock plugs on Power Inlet Box outputs ensure solid mating
  - Easy, 2-screw access to terminal strip via front of box

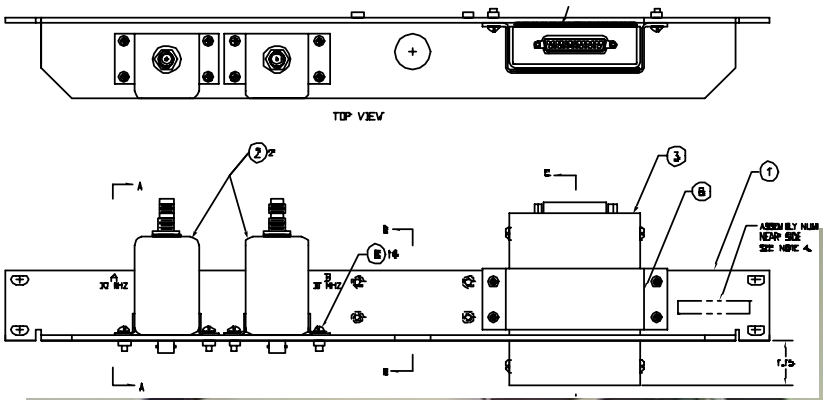




Power Inlet Box,
Inside Detail
(Note Terminal block)

Rack Mounting/Installation Hardware

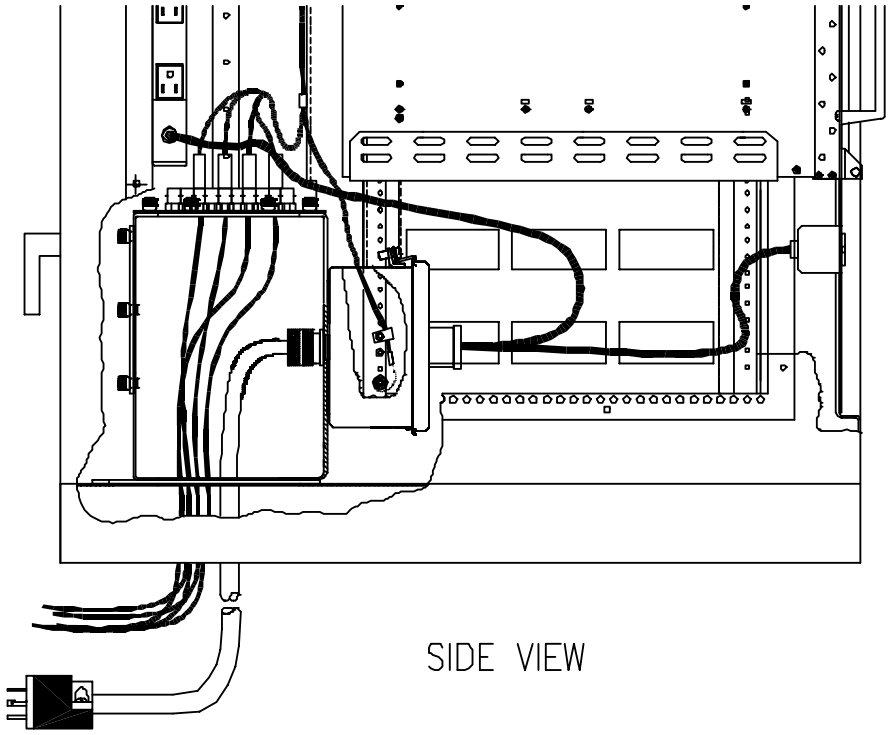
- **Slides and cable retractors**
  - DASCON
  - PTP (up to two)
- **Shelves**
  - All remaining DAS components
  - Cables will use fixed mounting (must be disconnected before equipment removal)
- **Balun/KVM rail**
  - Holds the two baluns associated with the 10 MHz Distribution Amplifier
  - Also holds the Keyboard/Video/Mouse (KVM) switch for DASCON (see diagram at right)



KVM Hardware Set

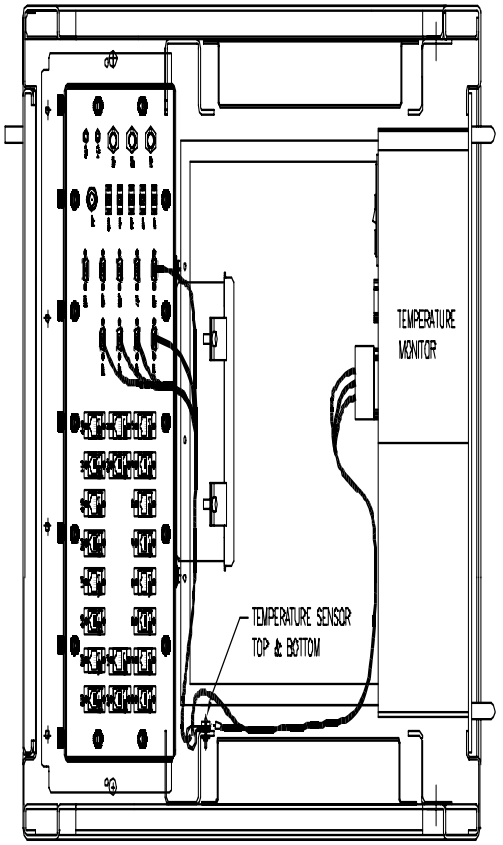
Rack Power Routing

- Power enters each rack from breakered 20A service in adjacent ac power raceway
- Power to raceway uses twist-lock plug, as does power connection from Power Inlet Box to ac outlet strip
- Terminal strip in Power Inlet Box accommodates up to 3 service inputs (up to 60A total)
- TrippLite ac outlet strip provides 24 ac outlets.



Rack Cable Routing

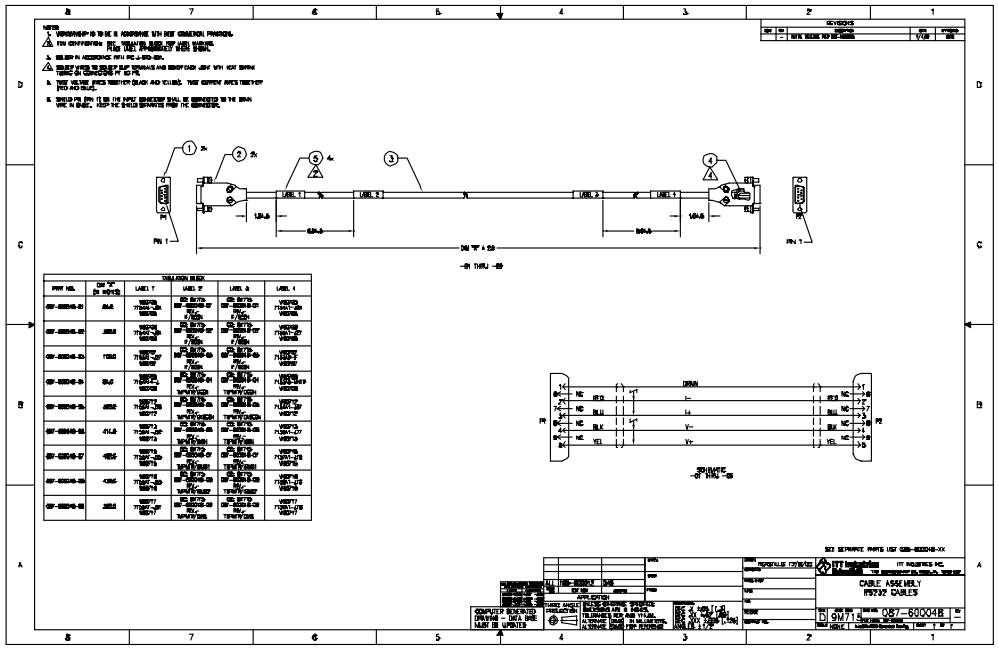
- **Cables**
  - Are routed internal to the rack (no cabl exposed on the front of the rack)
  - Are routed in right rear (as viewed fror the rear) of each cabinet
  - Terminate into I/O panels that use insulated feed-through connections
- **External Cables**
  - Routed per typical install diagram
  - 6' service loop on either end
  - Follow existing cable conduits and raceways (as presented in floorplans) remote equipment connections
- **Temperature Sensor mounted in top c each rack on rear rail. DCON rack alsc monitors inlet temperature at rack bottom (see detail).**



TOP VIEW

Cable Construction

- **STDN SPEC-8 Compliant (where applicable)**
- **Labeled per STDN SPEC 10 and 530 LOP-WSC-VII**
- **Formal drawings provide ‘families’ of cables with:**
  - Common pinouts
  - Common assembly instructions
  - Unique details, labels are called out using ‘-’ number

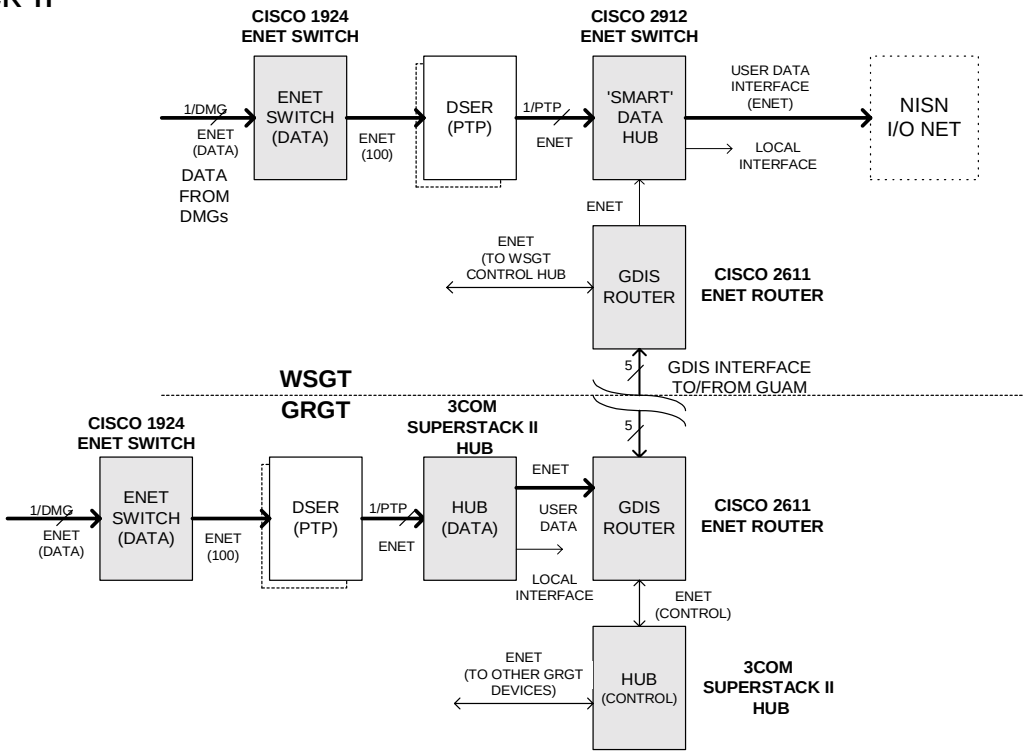


Workstation Desks, Printer, and KVM Switch

- **Wright-Line Workstation Desks**
  - Holds DASCON KVM Switch and Keyboard, Video Monitor (21”), Mouse, and Printer associated with DASCON at WSGT
  - Holds Printer at GRGT
  - ESD top and feet
  - Replicate of TGBFS workstation desk at WSGT
- **Printer**
  - HP 2100TN printer with Network Interface Card
  - Prints from all Controllers attached to the Control Hub
- **KVM Switch**
  - Black Box ACU3001A CAT5 KVM Micro Extender
  - Muxes Keyboard, Video and Mouse signals onto a single Cat5 cable for transmission to remote receiver (on Workstation Desk)
  - Transmits 1280 x 1024 video at distances up to 150 feet
  - Local module uses CPU power, remote module is powered by 9V universal power supply

Ethernet Equipment

- **Hubs**
  - 3COM 3C16441-US SuperStack II Hubs (used for ICON, DCON, DASCON, and Data hubs)
    - 12 Port
    - High Reliability
- **Ethernet Switches**
  - CISCO 1924 Switches used for both CDB Switch and the Data Switch
- **'Smart' Hub**
  - CISCO 2912 switch used for WSGT Local Interface
- **GDIS Router**
  - CISCO 2611
  - 1 port high speed serial WAN
  - 2 Enet ports
  - AIM Card (data compression)



Marking and Labeling

- **Rack Markings**
  - Labels on front of each rack denote 2-man lift, special equipment needed, or special connection instructions for each equipment in that rack
  - Rear door of each rack will hold labels denoting:
    - LRU Identification for each equipment
    - 'A' designations – used for determining cable routing
    - Special interconnect instructions
    - Manual operating procedures for selected manual operations such as:
      - 10 MHz Distribution Amplifier reset instructions
      - Simple directions for checking temperature, status
  - I/O Panels will list all connection points ('J' numbers assigned for each connection)
- **Cable Markings**
  - All ITT manufactured cables will be marked with the following:
    - 'W' and 'G' numbers as assigned by ITT and coordinated with WSC
    - ITT Part No. and revision level (for replacement purposes)
    - ITT FSCM Number (Cage Code)
    - Source and destination designators
    - Simple description of cable function